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COMMITTEE ON THE PEACEFUL
USES OF OUTER SPACE

REPORT ON THE UNITED NATIONS INTERNATIONAL TRAINING COURSE ON REMOTE-SENSING EDUCATION FOR EDUCATORS, HELD IN CO-OPERATION WITH THE GOVERNMENT OF SWEDEN

(Stockholm and Kiruna, Sweden, 14 May-15 June 1990)

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INTRODUCTION

A. Background and objectives

1. At its thirty-seventh session, the General Assembly adopted resolution 37/90 of 10 December 1982, in which it endorsed the recommendation of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82) that the United Nations Programme on Space Applications should promote the growth of indigenous nuclei and an autonomous technological base in space science and technology in developing countries.

2. At its thirty-second session, in June 1989, the Committee on the Peaceful Uses of Outer Space endorsed the activities of the United Nations Programme on Space Applications for 1990 as proposed by the Expert on Space Applications and as recommended by its Scientific and Technical Sub-Committee at its twenty-sixth session. Subsequently, the General Assembly, at its forty-fourth session, endorsed the activities of the Programme for 1990 (resolution 44/46 of 8 December 1989).

3. In response to resolution 44/46 and in accordance with the UNISPACE 82 recommendations, the United Nations Outer Space Affairs Division included, as an activity of its Space Applications Programme, the organization of a training course on remote-sensing education for educators in its programme of work for 1990.

4. The United Nations International Training Course on Remote Sensing Education for Educators was organized in co-operation with the Government of Sweden through the Swedish Agency for International Technical and Economic Co-operation (BITS) and hosted by the University of Stockholm and the Swedish Space Corporation for the benefit of Member States in the United Nations Economic Commission for Africa (ECA) region. The course was held at Stockholm and Kiruna from 14 May to 15 June 1990.

5. The main objective of the course was to develop the practical knowledge and skills of educators from African States in remote-sensing technology as well as to equip them with the ability to introduce elements of the technology, as may be appropriate, in the education curricula in their universities and institutes.

6. The present report, which covers the background, objectives and organization of the training course as well as a summary of the presentations, has been prepared for the Committee on the Peaceful Uses of Outer Space and its Scientific and Technical Sub-Committee. Participants in the course will report to the appropriate authorities in their respective countries.

7. The participants expressed their appreciation to the United Nations and the Government of Sweden for organizing and hosting the course, for their financial assistance and for the technical quality of the course.

B. Organization and programme

8. Participating in the course were 25 individuals from Algeria, Botswana, Burundi, Cameroon, Egypt, Ethiopia, Ghana, Guinea, Guinea-Bissau, Kenya, Malawi, Mozambique, Nigeria, Senegal, Sierra Leone, Swaziland, the United Republic of Tanzania, Uganda and Zambia, as well as from the United Nations Economic Commission for Africa (ECA), Addis Ababa, and the Regional Remote Sensing Centre at Ouagadougou. A list of the course participants is contained in annex I to the present report.

9. Funds allocated by the United Nations were used to defray the costs of international air travel for 13 participants and daily subsistence allowance for two lecturers invited from abroad. The Government of Sweden provided room and board, local transportation and pocket money for all the participants as well as international travel expenses for 10 participants.

10. The programme of the course was designed jointly by the United Nations Outer Space Affairs Division, the University of Stockholm and the Swedish Space Corporation (SSC). The United Nations was responsible for the overall external organizational arrangements and the Government of Sweden, through Stockholm University, SSC and BITS co-ordinated local arrangements and provided technical equipment, materials, course facilities and local transportation. The programme of the course is contained in annex II to the present report.

11. The course was opened by Ms. Gun-Britt Andersson, Assistant Under-Secretary, Ministry of Foreign Affairs, and Ms. Lena Wallensteen of the International Training Programmes of BITS, on behalf of the Government of Sweden; a welcoming telephone address was given by Dr. A. A. Abiodun, United Nations Expert on Space Applications. The United Nations welcoming statement was presented by Dr. S. Camacho, of the Outer Space Affairs Division.

12. The presentations at the course focused on problems of the development and use of remote-sensing technology in natural resource management and environmental planning, as well as on the development and introduction of remote-sensing education programmes in participants' countries. Other topics covered during the five-week training course included an overview of remote-sensing applications with emphasis on case studies in which data and satellite imagery of participants' own countries were used; principles of visual and digital image analysis; use of geographical information systems (GIS) in different fields of applications, and remote-sensing education. The participants were also provided with field work experience, practical exercises and training in relevant fields.

13. A number of the participants and invited lecturers made presentations on projects/programmes in which they were involved in their own countries. These presentations included the experiences and activities of the Regional Remote Sensing Centre at Ouagadougou; the development of remote-sensing educational programmes at the University of Botswana; and a case study in wood fuel inventory in Tanzania.

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14. Numerous practical exercises were organized in order to provide the participants with the opportunity of hands-on training in visual interpretation of remote-sensing data. The course was supplemented by on-site visits to the SSC ground station at Esrange and SSC facilities and laboratories at Satellitbild, Kiruna.

I. SUMMARY OF THE COURSE

A. An approach to an applied remote-sensing training strategy in a developing country

15. Up-to-date, reliable and readily available information about land and water is a prerequisite for the effective planning and management of natural and human resources. There is an increasing awareness in developing countries of the important role that remote-sensing techniques, in the form of aerial photographs and satellite imagery, can play in this context. The data which can be extracted from remote-sensing imagery, using a wide range of techniques is multisectoral and can be used for land-use planning and environmental protection, forestry and agriculture, geological and mineralogical exploration purposes, water resources inventories, communication, mapping and environmental monitoring.

16. In most developing countries, the need for this technology is well understood, and demands for the implementation of remote-sensing based programmes are growing. Considerable investment has been made in aerial photography (at a variety of scales) during the past decades, and it can be anticipated that a full, national coverage of satellite imagery has been or will be acquired. The major constraints on the wider and more efficient use of remote-sensing techniques are: (a) the lack of general knowledge of the real potential of remote-sensing technology at the managerial and decision-making levels; (b) the limited number of trained specialists; and (c) the lack of trained technicians at the local level.

17. There appears to be a need for three different types of training programme aimed at the following target groups:

(i) Managers (heads of agencies, heads of departments and decision makers); this should also include participants from non-technical groups;

(ii) "Specialists" - those who have gained experience in working with remote-sensing techniques and who have a basic knowledge of the scientific background of this technology;

(iii) Technicians (with emphasis on the local-level staff); this group usually has a very limited knowledge of remote-sensing but can be expected to become the most active users of the technique.

18. Three packages can be envisaged and tailored to meet the needs of the above three target groups. Such packages should include exhibition materials, manuals and audiovisual materials.

19. The course for management staff should consist of a very general overview of remote-sensing concepts and techniques and a presentation of current applications and future possibilities. Specific examples of applications in the country should be given together with general cost-benefit information. A question-and-answer technique should be encouraged. The exhibition will be a valuable presentation tool; other possibilities should be considered.

20. The course for specialists should be aimed at broadening and deepening that group's basic knowledge of remote sensing, including an understanding of and an ability to use more advanced image analysis systems. There should be a balance between theory and practical exercises. Since many of the specialists can be used as teachers in the training courses for technicians, the programme should also emphasize teaching methods. The course should include: the remote-sensing concept; aerial photography methods; basic photogrammetry; photo interpretation; satellite imagery and image analysis; image interpretation and mapping from satellite imagery; presentation of the results of photo and image analysis; comparisons of conventional and satellite methods; and the economic benefits of remote-sensing applications.

21. The course for technicians should be a "toned-down" version of the specialist course, tailored to meet practical requirements.

22. These training programmes can be organized as follows:

Management — One- or two-day seminars given once a year.

Specialists — Three-week courses, two to three times per year. A certain amount of customization will be done to meet specific sector interests.

Technicians — Two-week courses, four to five times per year; the teaching staff can be recruited from the specialists group.

In addition to these three types of training programmes, emphasis should be placed upon on-the-job training.

23. Investment in low-technology equipment such as mirror- and lens-stereoscopes, picture holders and clinometers will be necessary both for the training programme and to ensure that techniques taught can be implemented practically after training is completed and production begins. Lack of equipment and stationery, such as plastic overlays and colour pens, constitutes a major constraint to the implementation of the knowledge gained from training courses.

B. Land-use planning and environmental monitoring

24. Remote sensing data are a very important source of information for land-use planning and environmental monitoring purposes. These data are suitable for applications at the local or national level, as well as for regional or global studies. Of special interest for monitoring applications are the possibilities of using spacecraft to collect information over large areas on a regular basis.

25. Image interpretation as well as digital image-processing techniques are suitable tools for the evaluation of remote-sensing data for land-use planning and environmental monitoring. The purposes and goals of a specific study or an application and the availability of human and technical resources determine how these evaluation techniques can be used. The selection of appropriate data types and information is also crucial for the success of any specific applications.

26. For land-use planning activities, high-resolution space-borne data, e.g., SPOT or Landsat Thematic Mapper, provide an excellent data source, which often gives more recent information on the conditions in the local or regional areas than existing maps. Weather satellite data and routinely derived products (such as vegetation index maps over Africa for 10-day or one-month periods) are suitable for national or continental monitoring of the environment, e.g., vegetation development. Attempts by the Artemis project of the Food and Agriculture Organization of the United Nations (FAO) to estimate precipitation in Africa using polar-orbiting weather satellite data should provide interesting information on a 10-day and a one-month basis. Within the project, vegetation index maps for Africa with the same time intervals are also produced.

27. Land-use, land-cover or vegetation maps provide important information on the current extent of different land uses or land covers. Remote-sensing data can be used to identify at least major vegetation types and other land covers such as bare soils, water or build-up areas. From the land cover and spatial distribution it is also possible to deduce specific land uses, such as agricultural areas or residential areas. Other land uses, such as fora national park, cannot be determined with remote-sensing data without additional information.

28. Land-use or land-cover maps do not require the same level of detail as those used in agricultural or forest applications. It is often easier to produce (and it also requires less knowledge of the local conditions) a useful land-cover or land-use map of a given area than a detailed map of agricultural crops. Standard image interpretation techniques are very efficient for identification and mapping of all major land-use classes. Interpretation experience from areas with similar natural conditions can reduce to a minimum the need for field measurements.

29. In a typical false-colour infrared image, forest areas appear as different shades of dark red and brown, water areas appear bluish, agricultural areas with lush green vegetation appear in shades of red to light red and bare soils in bluish to white colors. Field patterns can often be identified; they provide indirect information on farm sizes and agricultural practices. Major highways and railroads can often be identified, and the distribution and development of more densely populated settlements are visible. Major topographic features such as valleys, plains and mountain ranges can be identified. With high-resolution panchromatic SPOT data (pixel size 10 m) it is often possible to map and identify additional features and land properties that are important for land-use planning, including areas unsuitable for agriculture due to poor soils, excessive slopes or flooding risk, minor roads, details of the road pattern in cities. Digital elevation models can also be derived from suitable stereo pairs of SPOT data.

30. Land-use, vegetation cover and other man-made or natural conditions are not static but dynamic and change with the passage of time. A knowledge of these changes is useful for arriving at planning decisions or in verifying the efficiency of environmental protection measures. In monitoring changes, the analyst should ensure that the observed differences between two images or data sets of a given ground location are not the result of external factors such as weather conditions or sensor characteristics. For example, two images of the same location, one taken during the dry season and the other near the end of the rainy season, typically differ in their appearance, mainly as a result of differences in the vegetation development and the distribution of agricultural crops and, subsequently, their spectral signatures. When used for the monitoring of the efficiency of erosion control measures or the extent of erosion, such an approach could however result in very serious misinterpretations.

31. Remote-sensing data can also be used for water resources management of both surface and ground water, which can be mapped indirectly by remote-sensing means; an instance of this would be the determination of the condition of vegetation in a given location.

32. Drainage systems, catchment areas and the extent of water in major rivers and lakes can be determined from satellite data. The interpretation of vegetation and soil types provides clues about the plants, available water, infiltration possibilities of water into the ground and expected surface runoff. In combination with weather data, it is thus possible to identify the areas with sufficient availability of water for different types of agriculture or rangeland use. Such information can also be used to estimate the expected surface runoff and its seasonal variation within catchment areas in order to provide essential information for the planning of reservoirs and dams for irrigation and electricity production.

C. Practical methods for field survey

33. In practice, a major pre-requisite to any successful interpretation of an aerial photograph or satellite imagery is the competence of the interpreter. His/her experience in remote-sensing techniques and pre-eminence in the intended subject area of interpretation are essential elements of such a competence.

34. If professional experience is salient, so is the field data. Through the use of satellite images, field control can be partially substituted by interpretation of conventional aerial photographs or oblique photographs taken by a conventional camera from a light aircraft during reconnaissance flights. However, ground truth is best established by studies on the ground. Soil colour and type, vegetation density and composition, farming systems and predominant land use, bed-rock type and micro relief are examples of reference data which can be collected by field surveys.

35. The collection of reference data can be a very expensive and time-consuming operation. Field reference data can consist of both time-critical and time-stable observations. Time-critical elements are associated with a changing environment in relation to time, such as vegetation type and cover and hydrological and soil

moisture conditions; the study of such elements is essential in interpreting multi-temporal or bi-temporal scenes. Time-stable elements are geological structures, landscape morphology and tectonic features. In image interpretation, the use of multi-temporal scenes can enhance the understanding of time-critical elements such as vegetation patterns which can be correlated with features such as topography, drainage and tectonics including mountain vegetation, riparian forests and ground-water flow/ground-water bushlands.

36. In applied remote sensing, theoretical sampling strategies such as random sampling of control points might not yield a positive result, since an actual project usually never allows researchers to spend enough time to develop new theories or to concentrate on sample spots that are inaccessible on the ground. Field control points must be established in relation to the objects that cannot be directly identified on the images. In a given satellite image, the analyst should select the field sample sites (which corresond to any feature of interest - such as vegetation or erosion type) and should use such sample sites as keys to identify other similar sites instead of undertaking a random sampling of such sites with the aid of a software package.

37. In obtaining ground truth within an area that is homogeneous in one aspect (topography, vegetation cover, etc.), it is possible to select the sampling points in a grid system related to the national grid system of the country concerned, the universal transverse mercator (UTM) net or to the true geographical co-ordinates.

38. The most practical method of establishing field controls is to concentrate the field observations on those sites that can be easily identified on images as well as on maps and in the terrain; such sites include road junctions, railway crossings, bridges, typical terrain features, hills, river banks and streams.

39. Whichever approach is selected, it is very important to take careful note of the terrain that is being observed, including vegetation type and density, land use, soil type and soil colour and bedrock geology. The field notes should be accompanied by simple topographical profiles illustrating the spatial relations between objects that constitute the image pattern.

D. Visit to Esrange Receiving Station

40. Since 1968, SSC has been operating a ground receiving facility for remote-sensing satellites at Esrange, 45 km from Kiruna.

41. At the station, data are acquired and transmitted in real time as each satellite passes over the station's coverage zone. Data acquired by the satellite from locations outside the station's perimeter (e.g., SPOT-1 and 2) can also be recorded on board the satellite and later downloaded to the acquisition station as the satellite passes over the coverage zone of the station. The ratio between on-board recorded data and directly transmitted data for the SPOT satellites is about 50:50.

42. Based on the satellite pre-orbital parameters, antenna pointing angle listings are calculated at the station so that the receiving antennae can be positioned in advance before the satellite passes. During a pass, the satellite is tracked automatically.

43. During a satellite overpass at the station, satellite data are recorded by high-density digital type recorders. Operators are able to observe the received data on a monitor in real time and can effect the necessary quality control.

44. The station currently receives data from Landsat, SPOT and MOS satellites. It was expected that ESA's ERS-1 and the remote-sensing satellite Resurs-1 of the USSR would be added to the list by the end of 1990. Co-located with the acquisition systems at SSC Esrange, are facilities for processing Landsat multispectral scanner (MSS), TM and MOS data. SPOT data are processed at SSC Satellitbild at Kurina.

45. On an average day, the following number of passes are received at SSC-Esrange:

	Passes/day
SPOT 1 and 2	6
Landsat 5 (TM and MSS)	4
MOS-1	3

The number of passes received is lower during the winter season, due to snow cover and low Sun elevation in the coverage zone.

46. ESA's ERS-1 data receiving station is now ready to receive data from the satellite as soon as it is launched in 1991.

II. COURSE EVALUATION

47. At the conclusion of the course, the participants were asked to complete a questionnaire regarding various aspects of the contents and organization of the course, including the time alloted to the topics and practical exercises as well as the relevance of the course content to their day-to-day activities. This exercise was followed by a discussion of problems of remote-sensing education in developing countries. During the discussions, the participants made a number of observations on the accomplishments of the course and recommendations for future courses.

48. All participants expressed the opinion that the general organization and the planning of the presentations were of high quality. Depending on their experience and field of expertise, some participants felt that more time should have been spent on topics related to geographical information systems (GIS) and remote-sensing education. All the participants were of the view that the level and conduct of the course were appropriate for the specific needs of their educational and academic work. The participants expressed their appreciation to the Government of Sweden and to the United Nations for having organized the training course.

Annex I

LIST OF PARTICIPANTS

Country/ organization	Name	Address
Algeria	Mr. Youcef Smara	Houari Boumediene University of Sciences and Technology Electronic Institute BP 32 El-Alia, Bab-Ezzouar Algiers
Botswana	Ms. Opha Pauline Dube	University of Botswana Private Bag 0022 Gaborone
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Country/ organization	Name	Address
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Country/ organization	Name	Address
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United Republic of Tanzania	Mr. Protas Kailembo Ndyetabula	Department of Animal Science Sokoine Univ. of Agriculture Box 3000 Chuo Kikuu-Morogoro
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Uganda	Mr. Christopher Muyanja	Department of Geography Makerere University P.O. Box 7062 Kampala
Zambia	Mr. Raynold Mbopisi Moyo	Survey Department Ministry of Lands and Natural Resources P.O. Box 50397 Lusaka

Annex II

PROGRAMME OF THE COURSE

I. INTRODUCTION

Date	Time	Subject	Speaker
Monday 14 May	9 a.m.	Welcome address on behalf of the Government of Sweden	G. Andersson
		Welcome address on behalf of BITS	L. Wallensteen
		Welcome address on behalf of the United Nations	S. Camacho
		Introductory lectures:	
	10 a.m.	Remote sensing: current status and future trends of the technology	L. Wastenson (Sweden)
	10.45 a.m.	Management of natural resources and the environment: role of remote sensing	A. Rapp (Sweden)
	11.30 a.m.	Remote sensing and global change	T. Rosswall (Sweden)
	1.30 p.m.	Education and training requirements in sensing technology	S. Camacho (United Nations)
	2.15 p.m.	Presentation of the Remote Sensing Laboratory at the Department of Physical Geography, Stockholm University	L. Wastenson (Sweden)

II. FUNDAMENTAL PRINCIPLES

Tuesday 15 May	9 a.m.	Principles of electro-magnetic radiation: reflectance/absorption/transmission colour, radiometry, the electro-magnetic spectrum, spectrometry, atmospheric transmission	J. Kleman (Sweden)
		Laboratory exercises and demonstrations on the principles of radiometry	J. Klemen (Sweden)
	1 p.m.	Principles of photography and optics: cameras, lenses, films, filters, processing, printing	J. Kleman (Sweden)

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Date	Time	Subject	Speaker
Wednesday 16 May	9 a.m.	Electronic imaging: television, scanning systems, multispectral images, image display and printing, infrared sensing,	F. Quiel (Sweden)
	1 p.m.	Non-imaging sensors: radiometers, altimeters, scatterometers, atmospheric profiling, ground measurements, calibration, microwave techniques	D. Gjessing (Norway)
Thursday 17 May	9 a.m.	Modern cartography in thematic mapping: the transfer of air photo and satellite data to thematic maps and the choice of classification systems and level of generalization	M. Buchroithner (Austria)
	1 p.m.	Image geometry and map projections: scale, projections, resolution, distortion, corrections	M. Buchroithner (Austria)
Friday 18 May	9 a.m.	Earth resources and environmental satellites: Earth resources satellites (Landsat, SPOT, ERTS-1 etc.), meteorological satellites, oceanographic satellites, orbits, ground stations, repetitive coverage, data products, ordering of data	H. Malstrom (Sweden)
		III. IMAGE INTERPRETATION	
Friday 18 May	1 p.m.	Image interpretation: tone and texture, shape and structure, delineation of features, supplementary information, contextual interpretation, map comparison, stereo viewing, topography, multi-temporal comparison	G. Alm (Sweden)
Week 2			
Monday 21 May	8.30 a.m.	Lectures on the use of images/maps for:	
		(a) Wood-fuel and biomass inventories	I. Kikula (United Rep. of Tanzania)
	10.30 a.m.	(b) Applications in agriculture: agricultural land use, soil surveying, identification and inventory, agrometeorology	P. Adeniyi (Nigeria)

Date	Time	Subject	Speaker
Monday 21 May	1.30 p.m.	Lecture on the use of images/maps for land-use planning and environmental monitoring: vegetation and land-use mapping, monitoring of urban development, planning of water resources development, monitoring of land degradation, pollution detection	F. Quiel (Sweden)
Tuesday 22 May	8.30 a.m.	Lecture on the use of images/maps for geological and related studies	M. Buchroithner (Austria)
	10.30 a.m.	Remote-sensing methods - examples from three projects:	M. Buchroithner (Austria)
		(i) Geological mapping in Hindu Kush, Pakistan, using SPOT, MSS, panchromatic large-format camera and hand-held Hasselblad stereo data	
	1.30 p.m.	(ii) Application of SPOT panchromatic stereo restitution and stereo interpretation for topographic and geo-scientific mapping in Nepal	
		(iii) The generation of a topographic-thematic map of the Tirich Mir massif in the Hindu Kush, Pakistan, employing Landsat TM and aerial photographs	
Wednesday 23 May	Morning	(a) Presentation of case study: remote sensing for land-use mapping in a semi-arid area in northwestern Nigeria: problems, methods and results	P. Adeniyi (Nigeria)
		(b) Visual interpretation of case-study material (participants work with material under instructor's guidance)	
	Afternoon	(a) Visual interpretation (continued)	
		(b) Pedagogic hints from the instructor; discussion	
Thursday 24 May	Morning	Presentation of case study:	I. Kikula (United Rep. of Tanzania)
		(a) A wood-fuel inventory in Tanzania: problems, methods and results	

Date	Time	Subject	Speaker
Thursday 24 May	Morning	(b) Visual interpretation of case-study material (participants work with material under instructor's guidance)	
	Afternoon	(a) Visual interpretation (continued)	
		(b) Pedagogic hints from the instructor; discussion	
Friday 25 May and Saturday 26 May		Presentation of and work with the following three case studies in alternating groups of eight or nine participants:	
		Land and water development inventories based on analysis of SPOT images (Wondo-Genet, Ethiopia)	R. A. Larsson (Sweden)
		Mapping of land degradation, soils, geology, geomorphology, hydrography, vegetation, land use, settlements and roads in Lesotho	B. Lunden (Sweden)
		Land-use mapping and environmental impact assessment for the Mtera dam, Tanzania	L. Stromqvist (Sweden)

IV. DIGITAL IMAGE PROCESSING, DIGITAL IMAGE ANALYSIS AND GEOGRAPHIC INFORMATION SYSTEMS

Week 3

Monday 28 May	9 a.m.	Digital analysis: Computer analysis programmes, types of computers, displays and printers, advantages and disadvantages and cost of computer analysis	W. Arnberg (Sweden)
	1 p.m.	Computer enhancement: density slicing, contrast stretching, edge enhancement, change detection, computer classification, methods for statistical analysis (including sampling theory and accuracies)	
Tuesday 29 May		Geographical information systems (GIS): theory and pratice	F. Quiel (Sweden)

Date	Time	Subject	Speaker
Wednesday 30 May	Morning	Demonstration of computer-aided image analysis	B. Lunden (Sweden)
		Exercise: participants perform digital image analysis on data from the case study	
	Afternoon	Exercise: digital image analysis (continued)	
Thursday 31 May	Morning	Geographical information systems: examples through presentation of case studies	F. Quiel (Sweden)
	Afternoon	Exercises on the use of GIS (practical exercises using case study material)	
		V. REMOTE-SENSING EDUCATION	
Friday 1 June	9 a.m.	Educational requirements in remote-sensing technology for national teaching and training programmes	F. Quiel (Sweden)
		A presentation of the five-week course in sensing given at the Remote Sensing Laboratory at the Department of Physical Geography, Stockholm University	W. Arnberg (Sweden)
		Special emphasis on training in visual and digital interpretation methods	W. Arnberg (Sweden)
	2 p.m.	Development of academical remote-sensing courses	W. Arnberg (Sweden)
		Handing out of group exercises: preparation of tentative drafts of remote-sensing courses or course elements at participants' universities. (Participants to present their drafts during section VIII, below); summary and evaluation	

Date	Time	Subject	Speaker
		VI. REMOTE-SENSING APPLICATIONS	
Week 4			
Monday 4 June		Fieldwork exercise	L. Stromqvist (Sweden) M. Orrmalm (Sweden)
Tuesday 5 June		Visit to SSC facilities at Esrange; live observation of remotely sensed data reception	J. O. Johansson (Sweden)
		Visit to ESA facilities at Salmijarvi	J. O. Johansson (Sweden)
		Visit to SSC Satimage facilities	M. Hedlin (Sweden)
Wednesday 6 June	9 a.m.	Planning and management of remote-sensing projects	M. Hedlin (Sweden) H. Olsson (Sweden) B. Paulsson (Sweden)
Thursday and Friday 7, 8 June		Practical exercises on material from participants' home countries or comparable areas; visual interpretation under the guidance of instructors	M. Bystrom (Sweden) E. Ahlcrona (Sweden) M. Orrmalm (Sweden)
Monday 11 June		Practical exercises on material from participants' home countries or comparable areas; visual interpretation under guidance of instructors	
Tuesday 12 June		Presentation of results from exercises	
		Presentation of current projects of SSC Satimage facilities	A. E. Oskog (Sweden)

Date	Time	Subject	Speaker
		VII. NEEDS OF THE USER	
Wednesday 13 June	9 a.m.	Data programming and retrieval, image production, enhanced pictures, copyright resolutions, availability of data and costs per area unit of various techniques	S. Forslund (Sweden) J. Unga (Sweden) T. Lahi (Sweden)
	1 p.m.	(a) How to divide which satellite data to order, and how to order it. Exchange of views between instructors and participants	
		(b) Trends in remote sensing: how will these affect third-world research and practice? Panel discussion	Dr. Stein W. Bie (Norway)
		VIII. SUMMARY AND EVALUATION	
Thursday 14 June	9 a.m.	Brief presentations of participants' drafts of remote-sensing courses or course elements needed at their universities; discussion and exchange of ideas regarding these drafts between participants and teachers	W. Arnberg (Sweden) R. A. Larsson (Sweden) B. Lunden (Sweden) F. Quiel (Sweden) L. Wastenson (Sweden) S. Chernikov (United Nations)
	1 p.m.	Summary and course evaluation	L. Wastenson (Sweden) S. Chernikov (United Nations)

UNITED
NATIONS

A

General Assembly

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5 October 1990

ORIGINAL: ENGLISH

COMMITTEE ON THE PEACEFUL
USES OF OUTER SPACE

REPORT OF THE EUROPEAN SPACE AGENCY

Note by the Secretariat

The European Space Agency (ESA) has submitted the attached report 1/ on its activities covering the year 1989 in English and French only.

Notes

1/ In view of the limited number of copies received, the report is distributed to the members of the Committee only.

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COMMITTEE ON THE PEACEFUL USES
OF OUTER SPACE

CO-ORDINATION OF OUTER SPACE ACTIVITIES WITHIN THE UNITED NATIONS SYSTEM: PROGRAMMES OF WORK FOR 1991 AND 1992 AND FUTURE YEARS

Report of the Secretary-General

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INTRODUCTORY NOTE

The present report has been prepared by the Secretary-General at the request of the Scientific and Technical Sub-Committee of the Committee on the Peaceful Uses of Outer Space and concerns efforts at co-ordinating the activities of organizations within the United Nations system that relate to assistance to developing countries in the practical application of space technology.*

The report is based on the contributions submitted by the organizations concerned in response to the United Nations request for information on concrete programmes of work envisaged primarily for 1991 and 1992 and was reviewed in its draft form at the Inter-Agency Meeting on Outer Space Activities, held at the headquarters of the Food and Agriculture Organization of the United Nations (FAO) from 26 to 28 September 1990.

The report consists of two sections: section I presents a summary of major activities and programmes planned for 1991 and 1992 and future years by the organizations within the United Nations system as a whole; section II presents concrete activities or programmes planned by individual organizations in an integrated form under substantive headings - remote sensing, communications, meteorology, hydrology, basic space science, use of space technology for maritime communications and for air navigation and other activities in the field of space science and technology and its applications - rather than under organizations by which they are conducted. At the same time, in order to help the reader identify the activities of each organization in specific fields, a matrix of outer space programmes and a list of organizations participating in outer space activities are provided.

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* This is the sixteenth such annual report. The first 15 reports were contained in documents A/AC.105/166, 183, 201, 223, 242 and 278, A/CONF.101/BP.11/Add.1, A/AC.105/309 and Corr.1, A/AC.105/325, 342, 359, 373, 389. 415 and 444 and Corr.1.

LIST OF ORGANIZATIONS PARTICIPATING IN OUTER SPACE ACTIVITIES

A. United Nations

Outer Space Affairs Division (OSAD)

Remote sensing - paragraphs 13 (a)-(e), (n)-(q), (s), 30, 37, 67, 69, 83, 84

Communications - paragraphs 85-86, 92 (a)-(c), 95-96, 106-107

Meteorology and hydrology - paragraphs 114, 121-122

Basic space science - paragraphs 142-143

Other activities in the field of space science and technology and its applications - paragraphs 151-152

International space activities - paragraph 154

Office of Legal Affairs (OLA)

Communications - paragraph 108

Other activities in the field of space science and technology and its applications - paragraph 153

Natural Resources and Energy Division of the Department of Technical Co-operation for Development (DTCD)

Remote sensing - paragraph 43

United Nations Disaster Relief Co-ordinator (UNDRO)

Communications - paragraphs 86, 90-91

United Nations Environment Programme (UNEP)

Remote sensing - paragraphs 15-17, 47, 49-50, 62, 66, 72-73, 81-82

Communications - paragraph 101

Meteorology - paragraphs 130-131, 139-140

United Nations Institute for Training and Research (UNITAR)

Remote sensing - paragraphs 16, 66

Economic Commission for Africa (ECA)

Remote sensing - paragraphs 18-27, 32, 38 (a)-(b), 64 (a)-(c), 71, 77

Communications - paragraphs 89, 94, 100 (a)-(b), 105

Meteorology - paragraphs 116, 119, 124, 137

Economic and Social Commission for Asia and the Pacific (ESCAP)

Remote sensing - paragraphs 13 (t)-(x), 33-36, 42, 44-46, 70

Communications - paragraph 86

Economic and Social Commission for Western Asia (ESCWA)

Remote sensing - paragraphs 62-63

B. Specialized agencies

Food and Agriculture Organization of the United Nations (FAO)

Remote sensing - paragraphs 13 (a)-(c), (e)-(p), (r), 14, 25, 29, 40-48, 51-54, 57, 59-61, 65, 74-75, 79-80

Communications - paragraphs 88, 98

Meteorology - paragraphs 114-115

United Nations Educational, Scientific and Cultural Organization (UNESCO)

Remote sensing - paragraphs 31 (a)-(f), 41, 55-56, 78

Communications - paragraphs 97 (a)-(h)

Meteorology - paragraph 139

International Civil Aviation Organization (ICAO)

Communications - paragraph 112

Land, maritime and aeronautical mobile services - paragraph 150

World Health Organization (WHO)

Remote sensing - paragraphs 29, 57-58

Communications - paragraphs 87, 99, 104

Land, maritime and aeronautical mobile services - paragraph 146

International Telecommunication Union (ITU)

Remote sensing - paragraphs 68, 76

Communications - paragraphs 93, 96, 102 (a)-(h), 103, 109-111

Meteorology - paragraphs 120, 141

Land, maritime and aeronautical mobile services - paragraphs 145, 149

World Meteorological Organization (WMO)

Remote sensing - paragraph 13 (b), (n)

Meteorology - paragraphs 114 (a)-(d), 115 (a)-(d), 116-117, 119, 123, 125-128, 130-136, 138, 140

Land, maritime and aeronautical mobile services - paragraph 145

International Maritime Organization (IMO)

Land, maritime and aeronautical mobile services - paragraphs 144-145, 147-148

World Intellectual Property Organization (WIPO)

Communications - paragraph 113

MATRIX OF OUTER SPACE PROGRAMMES*

	A				B				C			D	E	F	G
	1	2	3	4	1	2	3	4	1	2	3				
OSAD	13(a)-(e), (n)-(q), (s), 30	37, 67 57	69, 83	84(a)-(d)	85-86 92(a)-(c)	95	106, 107		114, 118	121, 122		142 143		151 152	154
NRED/TCD		43, 46													
ECA	18-28, 32	38(a)-(b) 64(a)-(c)	71, 77		89	94, 100	105(a)-(b)		116, 119	124	137				
ESCAP/ UNDP	13(t)-(x), 33-36	42, 44-46	70		86										
ESCWA			62, 63												
OLA								108						153	
UNEP	15-17	47, 49, 50 62, 66	72, 73 81, 82			101				130, 131 140					
UNDRO					86, 90 91										
UNITAR	16	66													
FAO	13(a)-(c), (e)-(p), (r), 14, 25,29	39, 40, 48 51-54, 57 59-61, 65	69, 74 75, 79 80(a)-(d)		88	98			115						
UNESCO	31(a)-(f)	41, 55, 56	78			97(a)-(h)				139					
ICAO								112					150		
WHO	21	57, 58			87	99	104						146		
ITU		68	76			93(a)-(e), 96	102(a)-(h), 103	109, 110 111	120		141		145, 149		
WMO	13(b), (n)								114(a)-(d) 115(a)-(d) 116-119	123(a)-(c)	125-127 128(a)-(d) 130-136, 138, 140		145		
IMO													144, 145, 147, 148		
WIPO								113							

* The capital letters and Arabic numerals in the column headings refer to the sections and subsections of section II of the present report. The numers in each column designate the relevant paragraphs.

ACRONYMS

ACMAD	African Centre of Meteorological Applications for Development
AOCRS	Association of Cartography and Remote Sensing (ECA)
ARABSAT	Arab Satellite Communications Organization
ARTEMIS	Africa Real Time Environmental Monitoring Using Imaging Satellite
AVHRR	Advanced very high resolution radiometer
CAS	Commission for Atmospheric Sciences
CCIR	International Radio Consultative Committee (ITU)
CCITT	International Telegraph and Telephone Consultative Committee (ITU)
CNS	Communication navigation and surveillance
COSPAR	Committee on Space Research
CRTO	Regional Centre for Remote Sensing at Ouagadougou (ECA)
CTD	Control of Tropical Disease (WHO)
DCP	Data collection platform
DIANA	Data and Information Available in Africa
ECLAC	Economic Commission for Latin America and the Caribbean
ESA	European Space Agency
FANS	Future Air Navigation System
FAORSC	FAO Remote Sensing Centre
GARS	Geological Applications of Remote Sensing
GAW	Global Atmosphere Watch (WMO)
GEMS	Global Environmental Monitoring System
GIEWS	Global Information and Early Warning System on Food Security (FAO)
GIS	Geographic Information System
GLONASS	Global Orbital Navigation Satellite System (USSR)
GMDSS	Global Maritime Distress and Safety System (IMO)
GPS	Global Positioning System (United States of America)
GRID	Global Resource Information Data base
GTS	Global Telecommunication System
HRSD	High-resolution satellite data
IACC	Inter-Agency Consultative Committee
IAMAP	International Association of Meteorology and Atmospheric Physics
ICSU	International Council of Scientific Unions

IFRB	International Frequency Registration Board (ITU)
IGADD	Inter-Governmental Authority on Drought and Development
IGOSS	Integrated Global Ocean Station System (UNESCO/WMO)
IHO	International Hydrographic Organization
IHP	International Hydrological Programme
ILEC	International Lake Environment Committee
INFOTERRA	International Referral System for Courses of Environmental Information (UNEP)
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOMAC	Indian Ocean Marine Affairs Co-operation
ILRAD	International Laboratory for Research on Animal Diseases
ISCCP	International Satellite Cloud Climatology Project
ISLSCP	International Satellite Land-Surface Climatology Project
ISPRA	European Community Joint Research Centre
ISRIC	International Soil Reference and Information Centre
ISSS	International Soil Survey Society
ISY	International Space Year
ITC	International Institute for Aerial Survey and Earth Sciences (Netherlands)
IUCN	International Union for Conservation of Nature
IUGS	International Union of Geological Sciences
LRSD	Low-resolution satellite data
NASA	National Aeronautics and Space Administration (United States)
NOAA	National Oceanic and Atmospheric Administration (United States)
RASCOM	Regional African Satellite Communications System
RCSSMRS	Regional Centre for Services in Survey, Mapping and Remote Sensing (ECA)
RECTAS	Regional Centre for Training in Aerospace and Surveys (ECA)
RRSP	Regional Remote Sensing Programme (ESCAP/UNDP)
SADCC	Southern African Development Co-ordination Conference
SAR	Synthetic Aperture Radar
SPOT	Experimental Earth Observation Satellite (France)
TIBOKA	Dutch Soil Survey Institute
TREDMAR	Training and Education in Marine Science (UNESCO)

UNISPACE 82	Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space
WGI	World Glacier Inventory
WRCP	World Climate Research Programme
WWW	World Weather Watch (WMO)

Section I

SUMMARY OF MAJOR ACTIVITIES AND PROGRAMMES PLANNED FOR 1991 AND 1992 AND FUTURE YEARS

1. The organizations within the United Nations system have planned activities for 1991 and 1992 and future years within the categories of remote sensing, communications, meteorology and hydrology. Organizations within the United Nations system will also conduct valuable outer space-related or -aided activities in basic space sciences and in land, maritime and aeronautical communications and other activities related to space science and technology and its applications. The planned activities generally range from education and training programmes through fellowships, training workshops and summer schools, to expert services and survey missions to identify specific areas of applications relevant to a given country or group of countries and to carry out relevant studies or pilot projects as well as to disseminate information on the status of technology. Also, organizations within the United Nations system are preparing regional feasibility studies and designing education training programmes in remote sensing and satellite communications to establish indigenous capabilities in developing countries. In addition, there are other ongoing activities relating to the regulation and utilization of space activities.

2. In the area of remote sensing, the United Nations and its specialized agencies have planned a number of international, regional and national training courses and workshops. They cover remote sensing applications in general as well as specialized topics such as the use of high-resolution satellite imagery in agricultural, fisheries and forestry applications, the use of low-resolution imagery from environmental satellites for early warning on crop monitoring for desert locust control in Africa, by the ARTEMIS system, the use of infra-red and radar systems in assessing and managing natural resources and the handling and management of georeferenced monitored data through the Global Resource Information Data base (GRID) of the Global Environmental Monitoring System (GEMS) as an aid to the development of natural resource surveying and mapping systems. Most of these international and regional training courses are jointly organized by two to four organizations within the United Nations system, often in co-operation with other international organizations and/or Governments. National courses on remote sensing applications are also planned in a number of developing countries. Fellowships in the area of remote sensing will also be offered in the 1991-1992 period by a number of international organizations and Member States.

3. Many of the organizations of the United Nations will offer expert services in their respective areas of competence. A number of pilot projects relying on remote sensing applications include forest resource assessment, desertification control, vegetation monitoring, natural disaster forecasting and assessment of their impact on geological mapping and mineral exploration, land use and natural hazards monitoring. Also, special projects are being carried out in marine pollution, vegetation monitoring and irrigation management. In the area of dissemination of

information on remote sensing technology, organizations either provide information upon request or issue newsletters and technical publications on regional or sectoral development of remote sensing capabilities.

4. Regarding communications, a number of projects, training courses, workshops and seminars are planned in such areas as applications of satellite technology to rural communication and use of communications systems to support primary health care, as well as search-and-rescue missions and disaster relief operations. Fellowships in the field of communications are also offered through the United Nations system with the co-operation of the agencies of Member States.

5. Various expert and technical advisory services are offered in the planning of global and regional satellite communications systems as well as Earth station projects and satellite communications, navigation and surveillance for international civil aviation. Regional study projects for establishing satellite communications networks are being carried out; one of particular importance is being carried out in the Regional African Satellite Communications System (RASCOM). In addition, the legal and regulatory aspects of the frequency spectrum for space communications will be considered. Furthermore, the organs concerned will disseminate information on services and studies and hold conferences to inform the Member States thereon.

6. A series of workshops and seminars are planned for 1991 and 1992 on various aspects of satellite meteorology and its applications. A number of technical co-operation activities in meteorology and operational hydrology are planned in Member States. In addition, activities on the use of space technology in the evaluation and management of marine resources, particularly on the Atlantic coast of Africa and in the Indian Ocean region, are being developed.

7. In sectors of development that depend on the application of meteorology and agro-meteorology, organizations within the United Nations system, including ECA, FAO, UNEP and WMO, plan courses, workshops and training courses in selected African countries. The World Weather Watch (WWW) increasingly uses satellite technology not only for obtaining meteorological information through remote sensing techniques but also for communications. The application of satellite technology forms an important element of technical co-operation activities in both meteorology and hydrology. An example of this is the use of satellite techniques in the tropical cyclone programme. Under the World Climate Programme, various climate monitoring activities will be undertaken involving the use of satellite data. A series of technical reports and publications on activities such as ozone depletion will be made available.

8. In basic space sciences, the United Nations has planned a workshop to benefit ESCAP member States. Also, a series of fellowships in space research, with a duration from one to three years, will be offered. The United Nations, through its Programme on Space Applications, will continue to collaborate with the Committee on Space Research (COSPAR) to support the space research activities of scientists from developing countries.

9. The work of the specialized agencies of the United Nations is also making significant contributions in new areas of applications of space technology for land, maritime and aeronautical mobile communications. For disaster management, the use of the satellite transceiver for prompt response is being assessed. Further progress is being made towards the development of the future global maritime distress and safety system (GMDSS), aiming at its introduction in stages beginning in the early 1990s, and ships will be encouraged to include satellite equipment for its uses. Another example is the application of satellites for the early identification of areas of agricultural drought and desert locust infestation.

10. In the use of mobile satellite services in air navigation, further progress is being made towards establishing air-ground data links for use by air traffic services.

11. The organizations within the United Nations system are also actively involved in promoting education and the development of skills at the local level in the field of space science and technology and its applications. These activities will be particularly emphasized during the 1991-1992 period, as part of International Space Year (ISY) and in furtherance of General Assembly resolution 44/46 of 8 December 1989, in which the Assembly endorsed the initiative of international scientific organizations and bodies to designate 1992 as International Space Year.

12. The Legal Sub-Committee of the United Nations Committee on the Peaceful Uses of Outer Space will continue to elaborate draft principles related to nuclear power sources in outer space, to consider matters relating to the definition of outer space and to the geostationary orbit and to consider legal aspects of the sharing of the benefits of the exploration and utilization of outer space, taking into account the needs of the developing countries.

Section II

ACTIVITIES PLANNED BY THE ORGANIZATIONS WITHIN THE UNITED NATIONS SYSTEM FOR 1991 AND 1992 AND FUTURE YEARS

A. REMOTE SENSING

1. Education and training programmes

Training courses/workshops/seminars

13. The following training courses/workshops/seminars are being planned by the organizations within the United Nations system in 1991 and 1992:

(a) Fifteenth United Nations/FAO International Training Course on Remote Sensing Applications in co-operation with the Government of Italy, Rome, 1991;

(b) Sixth United Nations/FAO/WMO/ESA Training Course; use of remote sensing systems in hydrological and agrometeorological applications for the benefit of ECLAC member States, 1991;

(c) United Nations/FAO/European Space Agency (ESA) Workshop on Microwave Remote Sensing Technology for benefit of ECA member States, 1991;

(d) United Nations International Training Course on Space Technology Applications to Global Change and Resource Management, in co-operation with the Government of the United States of America, Sioux Falls, South Dakota, September 1991;

(e) United Nations/FAO Workshop for decision-makers on the application of remote sensing for the benefit of ECA member States, 1991;

(f) FAO/ESA and Telespazio, International Seminar for Decision Makers on ARTEMIS and DIANA Technology, Rome/Fucino, June 1991;

(g) FAO/ESA Regional Training Course for West Africa on the Application of Synthetic Aperture Radar (SAR) Technology for Mapping, Assessment and Monitoring of Natural Resources, 1991;

(h) FAO/University of Reading, Meteosat Rainfall Estimation Calibration Workshop for Inter-Governmental Authority on Drought and Development (IGADD) and Southern African Drought and Development Community (SADCC) Regions, Nairobi, October 1991;

(i) FAO/International Institute for Aerial Survey and Earth Sciences (ITC), ARTEMIS and GIS Applications Training Course on Food Security Early Warning, Nairobi, November-December 1991;

(j) FAO regional training course on application of SAR imagery to vegetation and land use mapping and monitoring in co-operation with the Government of Canada, Costa Rica, 1991;

(k) FAO regional training course on forestry remote sensing applications, in co-operation with the Governments of Germany and Malaysia, 1991;

(l) FAO regional workshop on applications of GIS and remote sensing to inland fisheries and aquaculture, Abidjan, May 1991 (in French);

(m) FAO international training course on agricultural remote sensing applications, in co-operation with the Government of Hungary, Budapest, 1991;

(n) Seventh United Nations/FAO/WMO/ESA Training Course: use of remote sensing systems in hydrological and agrometrological applications for the benefit of ECA member States, 1992;

(o) United Nations/FAO/ESA regional workshop, in co-operation with the Government of France; remote sensing: a geo-information technology for decision makers - in Asia, 1991, and in Latin America, 1992;

(p) United Nations/FAO International Conference on Satellite Remote Sensing for Resource Management, Environmental Assessment and Global Change Studies, in co-operation with the Government of the United States, Washington, 1992;

(q) United Nations system workshop/symposium on the participation of developing countries in ISY, in co-operation with COSPAR and IAF, Washington, 1992;

(r) FAO/University of Reading, Meteosat rainfall estimation calibration workshop for IGADD and SADCC regions, Nairobi, May 1992;

(s) United Nations training courses on remote sensing applications for the benefit of small States in the South Pacific and in the Caribbean, 1992;

(t) The ESCAP/UNDP Regional Remote Sensing Programme (RRSP), through its education network, will organize two short-term training activities in 1991, one in Indonesia on land-use mapping and development planning and the other in Australia on the use of new-generation satellite data in geological applications and hazard analysis. In 1992, two more training activities are planned, one in China on the uses of microwave radar data and high-resolution satellite data for thematic mapping and one in the South Pacific, specifically related to remote sensing development in the small island countries of the South Pacific;

(u) RRSP will hold environmental monitoring seminars, including: multidisciplinary regional training workshop on the integrated use of remote sensing and GIS for resource management and environment monitoring in 1991, host facilities provided by Pakistan; an interregional seminar on remote sensing applications to disaster monitoring in 1991 hosted by China; and a symposium on remote sensing and GIS for global change monitoring planned for 1992, in Thailand;

(v) ESCAP/UNDP will hold its annual meetings of the Directors of the National Remote Sensing Centres/Programmes in the ESCAP region in 1991 in India and in 1992 in Pakistan; both meetings will be held in conjunction with the annual sessions of the Intergovernmental Consultative Committee (ICC) on RRSP;

(w) RRSP will organize with UNEP a workshop on GIS for environmental users for the Pacific subregion in Western Samoa in 1991. An RRSP workshop on low-cost, PC-based image processing and GIS technology for tropical resources mapping and development planning is planned for 1992;

(x) ESCAP/UNDP has planned working group meetings on the Regional Information Service (RIS) contact points and the RRSP education contact points for 1992.

14. FAO plans to continue its co-operation with the United Nations and the Government of Czechoslovakia in organizing international training courses on remote sensing applications to agriculture; it also plans to co-operate with UNEP and UNITAR in regional remote sensing and a GIS training course.

15. UNEP has implemented GRID as a major data management programme within GEMS. As part of its function GRID offers processed geo-referenced data sets at different scales based upon geo-referenced data provided by international and national agencies and organizations including the GEMS specialized data-bases. Many of the data sets available through GRID are based wholly or in part on information derived from space-borne sensors. At the moment there are two fully operational GRID centres, GRID-Nairobi at UNEP headquarters, and GRID-Geneva, as well as an additional facility in Bangkok. GRID-Arendal in Norway is a Norwegian sectoral centre. Major co-operating national space and technical agencies include the United States National Aeronautics and Space Administration (NASA), the United States National Oceanic and Atmospheric Administration (NOAA) and the United States Geological Survey Earth Resources Observation Systems (EROS) Data Center. There is an ongoing annual six-months-long Swiss sponsored Geographic Information System (GIS) training course administered in Switzerland by UNITAR under which fellowships are provided to participants from developing countries.

16. UNEP and UNITAR, with additional support from Switzerland, are conducting a series of four-month-long training courses under the GEMS-Africa programme to provide training in remote sensing and GIS technology to participants from African countries. Each country participating for the first time is provided on permanent loan with a microcomputer, peripherals and appropriate software. Training takes place at the Regional Centre for Services in Surveying, Mapping and Remote Sensing, Nairobi. Curricula are also being developed with the Asian Institute of Technology, Thailand, for a similar GEMS-Asia programme. On returning to their home countries, trainees will serve as a nucleus for a future national GRID-compatible centre.

17. UNEP and the United Nations Centre for Human Settlements (UNCHS) are collaborating in the use of satellite images as tools for urban area planning and management. This study, which entered its pilot phase during 1990, will eventually cover 20 major urban centres in developing countries. Both current and archive images will be processed to detect changes. The work is being done within the framework of GEMS using the GIS capabilities of GRID.

18. ECA, in co-operation with the Outer Space Affairs Division of the United Nations, plans to promote the "Development of Indigenous Capability in Remote Sensing Technology through the Provision of Relevant Education for Educators", with workshops, seminars and courses organized at regional, subregional and national levels.

19. ECA will organize two seminars for heads of national cartography and remote sensing institutions of Member States on new techniques in the application of remote sensing for resource development and management during May 1991. The seminars are intended to promote remote sensing technology as a major input towards achieving up-to-date map coverage and full knowledge of national natural resources as essential elements in development planning.

20. ECA plans to promote training in GIS for natural resources management and environmental monitoring and will hold at least two workshops in co-operation with other United Nations agencies and its Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) at Nairobi and Regional Centre for Training in Aerospace Surveys at Ile-Ife, Nigeria, in 1991 and subsequent years with a view to enhancing its applications as well as developing suitable curricula for schools and universities in Africa.

21. During 1991-1992 RCSSMRS plans to extend the duration of some of the regular short courses and upgrade their level to meet the expressed needs of Member States for future years.

22. RCSSMRS, in co-operation with the Government of France will organize several training courses in sectoral remote sensing applications for the Member States, both at the Centre and in France, during 1991 and 1992.

23. RCSSMRS in collaboration with UNEP and UNITAR, will host several courses on GIS. The courses will employ PCs which initially will be used for training; after completion of the course the participants will be provided with one PC on permanent loan to each country. UNEP will provide follow-up services, including installation and training in the countries.

24. RCSSMRS and ESA plan to organize a training course on Earth observation systems for natural resources management in December 1991 for participants from countries in the eastern and southern Africa subregion.

25. RCSSMRS and FAO, in co-operation with the Government of Japan have planned two to three training courses and workshops in early warning systems for IGADD and SADCC countries.

26. After the appointment of its new Director General, the ECA Regional Centre for Remote Sensing at Ouagadougou (CRTO) is reorganizing its training courses for 1991-1992 to meet identified current and long-term needs in resources inventory and management as expressed in new strategies of member countries and those within regional programmes such as the Observatoire du Sahara et du Sahel (OSS).

27. ECA and its Regional Centre for Training in Aerospace and Surveys (RECTAS) will continue to offer the Post-Graduate Diploma training course in remote sensing (see A/AC.105/444 para. 24). Furthermore RECTAS, in collaboration with the European Community, ITC and the French Government will consolidate the remote sensing training programmes of the Centre during 1991-1992 and beyond.

28. During 1991-1992 RECTAS will hold workshops and seminars on remote sensing in a number of member countries at the national level, emphasizing remote sensing applications in environmental monitoring, natural resources management and population census projects, tailored to national requirements.

29. The WHO Division of Control of Tropical Diseases (CTD) and the FAO Remote Sensing Centre continue to investigate the possibility of organizing a training course on the use of remote sensing in monitoring water resource development projects which could create habitats favourable to disease vectors.

Fellowships

30. The United Nations Programme on Space Applications, together with a number of Governments and international organizations, provides long-term fellowships for candidates from developing countries to undertake in-depth training, as follows:

(a) The Government of the Union of Soviet Socialist Republics intends to initiate a new fellowship programme with emphasis on remote sensing technology applications in the developing countries. The programme, which initially will benefit an anticipated 20 to 25 participants, will provide research opportunities in (i) development of new data analysis techniques, (ii) development of new instruments for remote sensing and (iii) development of space manufacturing (manufacturing of materials in space). The programme is a joint venture of GLAVKOSMOS, the State Committee on Public Education, Lumumba University and other research centres in the Soviet Union. The fellowship programme will be tenable at the Centre for Research and Studies for Foreign Specialists. Up to 50 per cent of the participants will be selected on the basis of bilateral arrangements between the USSR and other interested Governments; the remaining participants are to be invited under the auspices of the United Nations Space Applications Programme;

(b) The Brazilian Government has ongoing fellowships for 10 participants from Latin America and the Caribbean for training in remote sensing in 1991;

(c) ESA has renewed its offer of a one-year fellowship on remote sensing information systems tenable at the European Space Research Institute (ESRIN), Frascati, Italy, in 1991.

31. In the next few years UNESCO will support the following post-graduate training courses dealing with the applications of remote sensing to integrated natural resources research, management and development:

(a) International post-graduate training course in survey integration for development at ITC, Enschede, the Netherlands;

(b) Post-graduate course in integrated study and rational use of natural resources at the universities of Paris, Montpellier and Toulouse, France;

(c) International post-graduate training courses on remote sensing applications, digital image processing and aerospace surveys for applied geomorphology and engineering geology, at ITC, Enschede, the Netherlands;

(d) International post-graduate training course on photo-interpretation applied to civil engineering and to geology, at the Instituto Geográfica Agustín Codazzi (IGAC), Bogota;

(e) UNESCO's Training and Education in Marine Science (TREDMAR) Programme, carried out by the Division of Marine Sciences, finalized its first computer-based learning module on "some marine applications of satellite and airborne remote sensing" in 1989. The overall objective is to help strengthen international satellite oceanography training and education by setting up a network of lesson users and producers. A second module will become available during 1990, and a third in 1991;

(f) UNESCO co-operates with FAO in organizing post-graduate training in the use of remote sensing images in water resources studies; UNESCO, jointly with the WMO Commission for Marine Meteorology (CMM) and IGOSS, has established an ad hoc Group on Ocean Satellites and Remote Sensing, to begin work at the end of 1990.

32. ECA will continue to solicit fellowships from the United Nations and its specialized agencies as well as other donor countries and agencies.

33. ESCAP/UNDP-RRSP plans to offer 20 short-term fellowships for each of its four short-term training courses in 1991 and 1992. It also plans to offer eight travel grants each year in conjunction with matching fellowships offered by the countries of the region for long-term training.

34. RRSP plans to support one expert from each of the countries participating in the multidisciplinary meeting and the interregional seminar in 1991, and also in the symposium in 1992, with a total of 40 participants in 1991 and 20 in 1992.

35. RRSP will support one participant from each country for the directors' meetings in 1991 and 1992, with a total of 40 for two years. For the working group meeting in 1992 RRSP will support about 40 participants.

36. RRSP will award 15 fellowships for the workshop in the South Pacific in 1991 and plans to award 20 fellowships for the workshop on GIS in 1992.

2. Expert services and survey missions to identify specific areas of applications relevant to a given country or group of countries and to carry out specific studies on pilot projects

Provision of expert services

37. The United Nations will continue to provide technical advisory services to implement the proposal for establishing, within an existing viable institution, a remote sensing information programme in the ECA region.

38. ECA will organize advisory service missions to RCSSMRS, RECTAS and CRTO for the purpose of enhancing remote sensing technology and its applications through periodic review of the Centres' plans and strategies for the development of the technology at the Centres and their effectiveness and co-operation with member States in their respective catchment areas. Other ECA advisory serivces will include:

(a) ECA missions to member States on the evaluation of national remote sensing capabilities, covering manpower requirements and skills development, equipment and infrastructural facilities;

(b) Development by ECA in co-operation with the Association of Cartography and Remote Sensing (AOCRS) at Algiers, of continental strategies for and the design of coherent programmes that will assist member States in adopting relevant equipment and software for both analogue and digital analysis at reasonable cost.

39. The FAO Remote Sensing Centre (FAORSC) provides technical support to some 60 projects annually. FAO will gradually increase provision of advisory and information services on remote sensing applications to agriculture, forestry, rangelands, fisheries and on related institutional infrastructures, in response to increasing requests for assistance from Member States. This could accelerate when data from the European Earth Resources Satellite, ERS-1, becomes available in mid-1991.

40. FAO will continue to assist its regional offices, United Nations regional economic commissions and regional remote sensing centres in the efficient use of appropriate remote sensing technology for the mapping, assessment and monitoring of renewable natural resources and natural disasters.

41. UNESCO and UNDP are establishing a digital image processing laboratory in Ulan Bator, Mongolia, for the processing of multisensor, multilateral and multitemporal remote sensing data for scientific and economic purposes.

42. ESCAP/UNDP-RRSP will provide, on an as-needed basis, general remote sensing consultation to member countries' programmes during 1991 and 1992. When responding to requests for consultations that the RRSP staff members cannot quickly fulfil themselves, RRSP will serve as a co-ordinating office in providing member country consultants to other member countries. For such consultants, RRSP will provide support for communication or travel but no consulting fees. If needed, RRSP will also arrange consultants from FAO, DTCD or agencies outside the United Nations system.

Study and pilot projects

43. The Natural Resources and Energy Division (NRED) of the Department of Technical Co-operation for Development (DTCD) of the United Nations will continue to include and use new methodologies for resources exploration and studies related to the application of sophisticated digital image processing in response to requests from the Committee on Natural Resources. Also, in response to requests from States Members of the United Nations DTCD will continue to serve and assist in the design, execution and financing of remote sensing projects that have training, consultancy and delivery of equipment as major components.

44. ESCAP/UNDP-RRSP will continue in 1991 to implement three pilot projects initiated in 1990. They are the Malaysia/China pilot project on GIS for monitoring and evaluating soil erosion in tropical regions and the Islamic Republic of Iran/Pakistan pilot project on desertification using remote sensing and thematic mapping techniques and an urban development monitoring pilot project using comprehensive remote sensing technology with five regional member countries participating in it. Two more pilot projects, one on remote sensing and GIS applications to land ecological changes study and one on coastal zone development and fishery environment analysis, will be initiated in 1991 under TCDC collaboration within the region.

45. The RRSP will continue three of the above pilot projects and will initiate two new projects: one on the uses of microwave remote sensing and high resolution satellite imagery for resources mapping; and, one on vegetation mapping using low resolution satellite data in 1992.

46. RRSP will continue to implement the South Pacific subprogramme in 1991 and in 1992, with activities including one subregional and two national training programmes. In addition, there will be one subregional meeting in 1991 and another in 1992. RRSP staff members and TCDC consultants will be provided as required.

47. UNEP continues to make active use of remote sensing techniques within the framework of GEMS for the monitoring and assessment of natural resources. Regional and national scale (usually site-specific) studies are being carried out through GRID using geographical information and image analysing technologies. Current activities include updating of the African elephant data-base; determination of potential habitat suitability for the vector of the African livestock disease east coast fever; assessment of environmental conditions in Lake Songkla in southern Thailand; and determination of vegetation change in a transect across southern Argentina and Chile. These activities are carried out in close co-operation with experts from a wide range of co-operating organizations including NOAA, the European Community Joint Research Centre (ISPRA), the International Lake Environment Committee (ILEC) and the International Laboratory for Research on Animal Diseases (ILRAD).

48. FAO preparatory work for forest resources assessment (FRA) 1990 revealed remote sensing data was indispensable for data collection. An ad hoc group of experts from, inter alia, UNEP, FAO and ISPRA with will continue together with NASA, to use remote sensing in mapping forests on a global scale. Remote sensing

will therefore be an essential part of multilevel sampling design using low-resolution satellite data (LRSD) of NOAA for stratification of areas sub-sampled with high-resolution satellite data (HRSD). Collection of NOAA local-area-coverage data (1 km x 1 km resolution) will be initiated with other potential users, such as UNEP for global first-level forest/non-forest mapping up to a 1:1,000,000 scale. HSRD will be used to obtain more detailed forest classification and related statistical figures than can be achieved with LRSD; to monitor changes in forest cover using multitemporal HRSD; and to calibrate and verify classification results obtained from LRSD. A pilot study will be used to calculate the number of samples for predetermined accuracy. The results of this FRA will be presented at ISY in 1992.

49. UNEP, in co-operation with ISRIC, the International Soil Science Society (ISSS), ITC and the Dutch Soil Survey Institute (Stiboka) is carrying out a global assessment of soil degradation. A global soil degradation status map at an average scale of 1:10,000,000 has been prepared involving some 3,000 polygons; digitizing has been completed. The same organizations are carrying out the development of a world soils and terrain digital data base (SOTER) involving detailed soil and land mapping at a scale of 1:1,000,000. Surveys of the first two sites have been completed in Latin America (parts of Argentina, Brazil and Uruguay) and in North America (adjacent areas of the United States and Canada) respectively. Work on other sites is commencing. The full SOTER programme will take 10 to 15 years to complete. Satellite remote sensing products are being used to generate some of the data for both of these activities, as well as to check and compare material received from various participating institutions. Both activities form inputs into GEMS.

50. UNEP, through the GEMS programme and the work of its Desertification Control and Soil Units is using remotely sensed data in the field of desertification control. Activities include the preparation of a global desertification assessment map (1:10,000,000) to be completed in 1992 and the development of an associated geographical information system. Remote sensing data from SPOT is being used in the preparation of desertification maps of the Sahelian and Sudanian regions in a UNEP/French Government study started in 1987 and planned to continue until the end of 1991. The resultant maps will be included in a World Atlas of Desertification. The other maps of interest, also being prepared for the Atlas, are vegetation maps of Africa and of the world based on NDVI, SPOT and Landsat data prepared by ICIU, Toulouse, France. The Atlas is due for completion in time for the 1992 United Nations Conference on Environment and Development.

51. FAO will continue its development and provision of operational remote sensing and agrometeorological inputs into the FAO Global Information and Early Warning System on Food Security (GIEWS), including the Desert Locust Programme under its FAO Remote Sensing and Meteorological Data Users Committee and supported by the Governments of Japan and the Netherlands.

52. FAO will participate in the development and testing of operational methodology for the integration of remote sensing data with data from ground surveys and existing maps in GIS and for the efficient utilization of such an integrated data base. FAO will also follow closely developments in research applied to pattern

recognition, expert systems relevant to agriculture, forestry and fisheries applications.

53. FAO and ESA will continue their co-operation in developing appropriate techniques for the application of satellite SAR imagery to agriculture and forestry applications in developing countries. This co-operation, which includes the provision of training courses, is part of the preparations for the forthcoming launch of ERS-1, Radarsat and other earth resources satellites with SAR included in their sensors payload.

54. FAO, through its French Trust Fund remote sensing project, is continuing the implementation of pilot projects on the application of high-resolution SPOT imagery and geographic information systems in the agriculture, forestry and fisheries sectors in developing countries; the results will be published in FAORSC.

55. UNESCO and ITC initiated a co-operative programme entitled "Geo-information for environmentally sound management of natural resources". The programme will include integrated remote sensing research and training activities in the fields of ecology, hydrology and geology. In addition, seminars for high-level decision-makers in these fields will be organized.

56. UNESCO, with the International Union of Geological Sciences (IUGS) and the Royal Museum of Central Africa (Belgium), are organizing the second phase of the Geological Appliations of Remote Sensing (GARS) African project focusing on the transfer of technology to Burundi, Tanzania, Uganda and Zambia. Also, with IUGS, UNESCO is initiating a new research project also known as Geological Applications of Remote Sensing (GARS) for the use of satellite imagery for the mitigation of national hazards in the Andean region.

57. The WHO Programmes of Tropical Diseases Research (TDR), CTD and Environmental Health (EH) continue to investigate the opportunities offered by remote sensing for improving research and control of vector-borne diseases. The WHO-executed Onchoceriasis Control Programme is currently expanding its network and the tele-transmission of hydrological information through its own emitting and receiving stations in 11 West African countries. WHO and FAO are planning a joint pilot project.

58. The WHO Division of Emergency Relief Operations, together with one of its collaborating centres, has developed a global disaster events data base that covers disasters since 1900 and is constantly being updated. Information systems are also being developed for health management of disasters, with appropriate linkages to the early warning systems.

59. FAO will use data from the ARTEMIS system to update and improve estimates of the length of the growing period, particularly in the Sahel region, in order to ascertain any changes in population-supporting capacity owing to climate fluctuations or changes.

60. The Fisheries Department of FAO will include remote sensing in the forthcoming workshops on GIS applications in aquaculture, with one in the Middle East in 1991.

Remote sensing will be an activity of the forthcoming Lake Tanganyika fishery resources project (GCP/RAF/227/FIN) and, more broadly, the ARTEMIS second phase will include an inland fisheries component. Remote sensing will be increasingly used for fishery and aquaculture field projects in 1991-1992 and future years.

61. FAORSC will continue to provide technical assistance to the Forestry Department in the assessment of existing forest resources and trends in deforestation, forest degradation and plantations. Field projects leading to assessment at national levels are assisted by national and international institutes and agencies in the dissemination of new technologies and know-how. In the latter field, activities in 1991-1992 will focus on the dissemination of information and transfer of know-how related to image data from SPOT, Landsat-TM and NOAA/AVHRR and their integration in geographic information systems.

62. ESCWA has implemented the first stage of a project entitled "Assessment of water resources by using remote sensing techniques in the ESCWA region". This first phase included the assessment of watersheds in Wadi Bana shared by Saudi Arabia and Jordan, and the water basin in Wadi Bana shared between Democratic Yemen and the Yemen Arab Republic.* ESCWA and UNEP will jointly implement the second phase of the project. UNEP will contribute in kind a total of $200,000 and finance the training. The Islamic Development Bank has allocated $200,000 to support this phase.

63. ESCWA has formulated two project proposals from extrabudgetary resources. The The first is a programme entitled "Assessment of Water Resources by Using Remote Sensing Techniques in the ESCWA Region", the first phase of which is entitled "Development of indigenous capability of remote sensing technology through the provision of relevant education for educators". An expert group will review the project in late 1990 prior to submission to UNDP.

64. During the period 1991-1992, ECA's RCSSMRS will be executing the following projects:

(a) RCSSMRS, in collaboration with FAO/Japan will continue to host and support the remote sensing component of the Early Warning Systems pilot project for the IGADD countries (see A/AC.104/444 and Corr.1, para. 61 (c));

(b) RCSSMRS will continue to promote the project on natural resources data analysis and management by GIS in collaboration with UNEP and UNITAR (see A/AC.105/444 and Corr.1, para. 61 (d));

(c) RECTAS, in collaboration with the Institute of Ecology at Ile-Ife, Nigeria, will conduct a pilot study on land use and environmental monitoring using remote sensing data in a selected district in Nigeria.

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* On 22 May 1990 Democratic Yemen and Yemen merged to form a single State. Since that date they have been represented as one Member with the name "Yemen".

65. FAO will complete phase I of two regional remote sensing/food security early warning projects covering the countries of IGADD and SADDC, with funding by the Japanese Trust Fund. The projects are establishing ARTEMIS data processing capabilities at Nairobi (RCSSMRS premises) and at Harare (Meteorological Department) that will process information product data flows to support food security and early warning operations at the regional and national levels in both regions.

66. UNEP and UNITAR will collaborate in carrying out studies of natural resources data analysis and management by GIS. The microcomputer-based GIS installed at RCSSMRS will be used to train nationals of member countries in the management of natural resources data. This is a pilot project with provision for demonstration projects which will last until 1992. UNDP is funding the project with the World Bank as the executing agency.

67. The Indian Ocean Marine Affairs Co-operation (IOMAC) programme, in collaboration with the United Nations Outer Space Affairs Division, is planning to undertake small-scale feasibility projects of satellite remote sensing applications for mapping, monitoring and managing of coastal resources in Indonesia, Sri Lanka and Tanzania. In future years, the project will be expanded and extended to benefit other Member States of the subregion.

68. The International Radio Consultative Committee (CCIR) of ITU will continue its studies relating to remote sensing systems within the framework of its study group 7. The XVIIth CCIR Plenary Assembly (Dusseldorf, Germany,* May-June 1990) approved the results of studies during the period 1986-1990 and the work programme for the next study period.

3. Dissemination of information on the status of technology

Continuing activities

69. In 1989, the United Nations Space Application Programme began an annual publication of a collection of papers selected from among those presented at the meetings, workshops and training courses organized under its auspices. This publication covers different aspects of space science and technology including remote sensing, satellite meteorology, satellite communications and basic space science. The publication includes papers that are broad in scope and have enduring interest.

70. ESCAP/UNDP will continue to operate the Regional Information Service (RIS) on remote sensing during 1991 and 1992 and onward, providing important and interesting

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* Through accession of the German Democratic Republic to the Federal Republic of Germany with effect from 3 October 1990, the two German States have united to form one sovereign State. As from the date of unification, the Federal Republic of Germany acts in the United Nations under the designation "Germany".

RIS output. Four issues of the newsletter and two issues of the Asian-Pacific Remote Sensing Journal will be published in 1991 and 1992. Reports and proceedings of seminars/workshops/meetings will continue to be published regularly.

71. ECA and the United Nations Outer Space Affairs Division, in collaboration with the ECA-sponsored regional centres at Ile-Ife, Nairobi, and Ouagadougou and the Pan African Documentation Information System (PADIS), will implement the programme on a remote sensing information system for Africa (1990-1991) with UNDP funding for the fourth cycle programme for Africa (see A/AC.105/444 and Corr.1, para. 64). UNDP funds are still expected.

72. UNEP, through the International Referral System for Courses of Environmental Information (INFOTERRA), has over 200 registered sources that provide information on remote sensing or use the technique in their activities relating to pollution monitoring, resource mapping, atmosphere and climate. Additional sources will be registered in the next few years.

73. UNEP, through the Monitoring and Assessment Research Centre (MARC), produces Environment Data Report, a biennial compendium of environmentally related data, the next edition of which will be published in 1991. Satellite-derived data are included in many sections of the report, most notably those dealing with climate, oceans, aquatic resources, land cover and land resources. Many of the co-operative international environment related satellite programmes will be outlined. Data illustrating trends in the numbers of satellites in geostationary orbit will also be featured.

74. FAO will continue to publish review and technical reports on agriculture, fisheries and forestry applications of remote sensing and GIS in 1991-1992 and future years.

75. FAO plans to strengthen further its role as the clearing-house for information on the agricultural, forestry and fisheries applications of remote sensing. In 1991 its Remote Sensing Centre will begin publishing a quarterly FAO Remote Sensing Newsletter.

76. ITU will publish in the period 1990-1992 CCIR volume II, containing the texts concerning remote sensing systems as approved by the XVIIth CCIR Plenary Assembly (1990).

77. ECA, in addition to its regional centres' newsletters, will publish annually the bulletin on cartography and remote sensing technology which will provide the useful information and data concerning this technology to a wide cross-section of readers, among them planners, technologists and educators.

Special projects or ad hoc activities

78. The UNESCO Intergovernmental Oceanographic Commission (IOC)/WMO Joint Working Committee for the Integrated Global Ocean Stations System (IGOSS) is at present studying the operational exchange of remotely sensed oceanographic data as a part of the IGOSS data processing and services system. Archiving and the exchange of

non-operational remotely sensed oceanographic data are being studied by the IOC Technical Committee on International Oceanographic Data and Information Exchange (IODE) (see A/AC.105/389, para. 41). Revision of the marine environmental data information (MEDI) referral system operated by IOC (see A/AC.105/373, para. 37) is currently being studied. Within the framework of the IOC Global Investigation of Pollution in the Marine Environment (GIPME), the possibility of using remotely sensed data to monitor marine pollution is being studied through groups of experts and case studies. Studies will be carried out on applications of remote sensing in coastal zone and shelf seas dynamic studies. IOC has initiated consultations on the potential satellite observing systems in the 1990s for oceanography and its future role.

79. FAO will continue the regional monitoring of vegetation and precipitation in Africa, the Near East and Asia by ARTEMIS, which has been operational since August 1988 and which will be further upgraded during 1991 with additional hardware and software capabilities to meet expanding user demands at the international, national and regional levels. The ARTEMIS 10-day and monthly image maps are used for the early identification of high-risk areas for migratory pests, such as desert locusts, as well as areas that may suffer from agricultural drought, and other natural disasters such as floods. FAO also provides ARTEMIS image and digital products to regional and national food security and desert locust control programmes in the IGADD and SADCC countries.

80. With the transfer of its Agrometeorology Group from the Plant Production and Protection Division to the Remote Sensing Centre's Research and Technology Development division, FAO will integrate remote sensing and agrometeorological data/information input to the FAO GIEWS and Desert Locust Programme. In co-operation with the University of Arizona, United States, a hardware/software capability, based on the use of microcomputers, is being defined to support this integration. Other FAO projects to be carried out in co-operation with other agencies include the following:

(a) In 1990 FAO will initiate the implementation of a three-year United States Agency for International Development (USAID) funded project for model forecasting for the simulating of the Nile River in order to improve irrigation management in Egypt through timelier and more accurate forecasts of inflow into Lake Nasser which provides inter-annual regulation to the Nile. The activities will include the establishment of a Nile Forecasting Centre and development of a model using remote sensing data in real time for the estimation of rainfall across the nine countries in the basin;

(b) Under the auspices of a Libyan trust fund, FAO will begin implementation of a three-year project aimed at mapping the natural resources for agricultural use and planning. The project will realize the establishment of an agricultural resource information centre which will co-ordinate the creation of a resource data base. This institution will be further strengthened through the establishment of a remote sensing centre which will generate the imagery required for mapping of natural resources and the monitoring of agricultural change;

(c) Under a programme of assistance to Afghanistan jointly funded by UNDP and the Office of the Co-ordinator for Humanitarian and Economic Assistance relating to

Afghanistan (UNOCA), FAO will prepare a systematic land-cover map at 1:250,000 of the whole country as a basis for planning agricultural statistical reporting and rehabilitation. It is further proposed to utilize remotely sensed data to assess changes in the agricultural land cover;

(d) In its regular programme and field activities for the coming year, the Land and Water Development Division of FAO foresees an intensification of the use of remote sensing techniques in the following applications: moisture régime analysis, using rainfall spatial distributions and estimates derived from satellite data; effect of climatic change on land resources and land carrying capacities; and soil erosion and land degradation assessment.

81. UNEP, through its GEMS, in conjunction with ILEC, is continuing to use GRID GIS for ascertaining the influence of watersheds on lake water quality. It will focus initially on Lake Biwa (Japan) and Lac Léman, Switzerland, making full use, inter alia, of high-resolution satellite data.

82. The International Union for Conservation of Nature (IUCN)/World Wildlife Fund (WWF)/UNEP World Conservation Monitoring Centre (WCMC) is producing an Atlas of Tropical Moist Forests to contribute to GEMS. The Atlas, containing maps at varying scales, will be published in 1991 and has been prepared on a GIS basis so that digital data sets will also be available. National agencies contributed satellite images for the preparation of the maps.

4. Establishment of Centres for space science and technology education

83. The United Nations Space Applications Programme has convened three regional meetings of experts on space science and technology and its applications within the framework of educational systems as well as an international meeting of experts on the development of skills and knowledge in remote sensing technology in the developing countries. The deliberations and the recommendations of the meetings specifically focused on the need for the United Nations to take a major leadership role in promoting the necessary educational opportunities, particularly in the developing countries, for the integration of space science and technology into national educational programmes. These recommendations have subsequently been developed into a project document for the establishment of regional centres for space science and technology education in existing national/regional educational institutions in Africa, Asia and the Pacific, Latin America and the Caribbean, and Western Asia. This is in conformity with the recommendation of the General Assembly, in its resolution 45/72 of 11 December 1990, that the United Nations serve as an instrument for the establishment of regional Centres for Space Science and Technology Education in developing countries.

84. Each of the Centres will be housed in a major science-and-technology-oriented university or a space research institution with an ongoing education programme to afford the Centre optimal utilization of the existing professional staff and physical infrastructure at the host institution. The Centre's initial programme will focus on remote sensing technology and related application disciplines. Each of the Centres will be specifically designed so that it may:

(a) Contribute significantly to indigenous capability development in remote sensing, including satellite meteorology and environment-related disciplines in each participating country;

(b) Enhance scientific and technical education in each participating country;

(c) Enhance the quality and quantity of contributions of graduates of participating countries in overall development of their respective nations and in the management of their resources and their environment;

(d) Strengthen the capabilities of institutions of higher learning, and national/regional remote sensing user assistance and training centres.

B. COMMUNICATIONS

1. Education and training programmes

Training courses/workshops/seminars

85. The United Nations Space Applications Programme plans to organize a Workshop on Space Communications for Development in co-operation with the Government of the USSR, to be held at Dubna, USSR, in 1992.

86. The United Nations/UNDRO/ESCAP/UNDP workshop on applications of space technology to minimize and alleviate the impact of natural disasters in China, is to be held at Beijing in September 1991.

87. WHO will continue its efforts towards the development and strengthening of communications systems support to primary health care in remote areas. The activities will include increasing training opportunities and the promotion of intersectoral collaboration and technical co-operation among developing countries (see A/AC.105/415, para. 68).

88. FAO, jointly with ESA, will organize a training course for operators of DIANA telecommunication terminals at Fucino, Italy, in 1991.

89. ECA in collaboration with the Government of the USSR, is planning to organize a seminar on satellite communications and its applications to participants from Member States during 1991-1992.

90. UNDRO, following its 1990 International Conference on Disaster Communications, identified its major needs and recommended that the use of satellite communications and remote sensing be used for preparedness and prevention for the years 1991-1992 and beyond.

91. UNDRO is processing radio satellite terminals for disaster communications that will be followed by an UNDRO training course for the years 1991-1992 and beyond.

Fellowships

92. Through the United Nations Programme on Space Applications, Governments and international organizations are providing long-range fellowship support for candidates from developing countries as follows:

(a) The Government of Austria has renewed its offer of two fellowships for study and training in the area of microwave technology for satellite communication. These fellowships are tenable in 1990-1991 at the Technical University of Graz, Austria;

(b) ESA has renewed its offer of a one-year fellowship in the field of communications engineering tenable at the European Space and Technology Centre (ESTEC), Noordwijk, the Netherlands, in 1991;

(c) ESA is offering a one-year fellowship in the area of satellite communications tenable also at the European Space Research and Technology Centre, Noordwijk, the Netherlands, in 1991.

2. Expert services and survey missions to identify specific areas of applications relevant to a given country or group of countries and to carry out specific studies on pilot projects

Provision of expert services

93. ITU activities in the area of satellite communications include the following:

(a) The ITU will continue to provide, at the request of telecommunications administrations, experts participating in the planning of regional or domestic satellite communication systems, as well as Earth station projects;

(b) ITU will also organize and provide lecturers for space communications seminars;

(c) ITU will provide expert advice on satellite broadcasting to the Saudi Arabian Ministry of Information until February 1992;

(d) The provision of specialized expert services to the Romanian Electronics Research Institute in the design of meteorological ground stations is foreseen up to 1991, but the activities will be reconsidered and the project document revised;

(e) IFRB will continue to inform administrations regularly through its Weekly Circular and the special sections annexed thereto of frequency assignments and orbital positions communicated to the Board in the space radiocommunication services. It will also respond to requests for advice from administrations on specific topics or providing information and documents, mainly in relation to space radiocommunication services.

94. ECA will continue to provide short-term technical assistance in the form of advisory services, specific studies and seminars for Member States'

telecommunications organizations for strengthening institutional capabilities and effectiveness in national development.

Study and pilot projects

95. The United Nations Space Applications Programme is collaborating with the Government of China in developing a satellite communications and television education programme for China.

96. The completion of the feasibility study for RASCOM, with ITU as lead agency co-ordinator, is expected before the end of 1990. The project consists of national and regional-level studies and encompasses all aspects of telecommunication requirements. It proposes a judicious mix of solutions in the various modes of media, terrestrial as well as space-borne, for the development of telecommunications in Africa. The project's report will be presented by the end of 1990 to the Conference of African Ministers of Telecommunications in order for it to take appropriate action that will affect ITU's decisions for activities in 1991, 1992 and future years.

97. UNESCO activities include the following:

(a) UNESCO, as a member of Inter-Agency Co-Ordinating Committee (IACC), is participating actively in the feasibility study of RASCOM that should be completed by the end of 1990 and submitted to the Conference on Ministers of Transport and Communications in 1991;

(b) In the context of the World Decade for Cultural Development, for which UNESCO is the lead agency, a feasibility study will also be undertaken to determine the terms of reference of a world-wide satellite network;

(c) UNESCO participates as an observer in the Arab League's Communication and Information Permanent Committee, which plans activities carried out by the Arab States Broadcasting Union (ASBU) and the Arab Satellite Communications Organization (ARABSAT);

(d) With respect to the decisions and recommendations of UNISPACE 82, UNESCO and the International Programme for the Development of Communications (IPDC) will continue to make every effort, within the scope of their mandate and subject to the availability of financial resources, to assist all Member States, in particular the developing countries, to promote the use of space technology for economic, social and cultural development;

(e) In collaboration with international and regional space agencies, UNESCO is ready to help in the testing of low-cost Earth stations and, if appropriate, to participate in joint ventures between the agencies. Such ventures would be designed to facilitate communication from any place in the world, especially in remote areas, e.g., journalists on field missions, broadcasters covering events, etc.;

(f) UNESCO is in the process of establishing a memorandum of understanding of co-operation with ESA, the first in a series of similar agreements proposed in the field of space co-operation;

(g) The promotion, in various forms, of the Convention relating to the distribution of programme-carrying signals transmitted by satellite (1974 Brussels Convention) will continue in 1991. UNESCO, in collaboration with WIPO and the International Labour Organisation (ILO), will continue to study the different aspects of the problem that relate to other conventions, e.g. the Rome Convention, raised in relation to the law concerning cable and satellite transmission;

(h) UNESCO is initiating a feasibility study on the creation of low-cost satellite communications system (LOCSYST) for development and environmental protection that will be conducted in co-operation with the United Nations, space agencies and interested Member States.

98. FAO, in co-operation with ESA, will implement in 1992 the DIANA satellite communication system, being developed by European industry under ESA management on a demonstration basis for a one-year period with a hub centre in Rome and terminals at Harare, Nairobi and Accra. Also, UNEP will continue to be associated with this activity through ESA.

99. WHO continues to follow the progress of the development of satellite networks to improve health conditions, particularly for enhanced communications support in rural areas. Also, WHO is following the feasibility study of RASCOM for its contribution to improved communications to and between those geographic areas that have either poor or non-existent communication facilities, needed, inter alia, as support to health services.

100. ECA, as a member of IACC, is following the finalization of the RASCOM feasibility study. The RASCOM project is expected to supplement the Pan-African Telecommunications (PANAFTEL) Network in meeting the telecommunications requirements of each African country, especially extending service to rural populations and linking subregional and neighbouring countries, as follows:

(a) Preparatory activities for the launching of a regional communications satellite into orbit will begin immediately after the ECA Conference of Ministers have taken a positive decision on this project;

(b) ECA will establish during 1991-1992 at least one rural telecommunications pilot project aimed at demonstrating the flexibility, effectiveness and economy of telecommunications for providing basic communication services to rural communities and to support other development programmes, through satellite relay systems.

101. At UNEP headquarters, GRID-Nairobi's reliance on telecommunications, via satellite both within and outside Africa, are expected to continue to grow. An anticipated consequence of the establishment of a GRID-compatible national centre in 15 African countries, through the GEMS-Africa programme, is the growing two-way traffic in remote-sensing and thematic data between those centres and the archives at GEMS/GRID in Nairobi.

3. Dissemination of information on the status of technology

102. ITU permanent organs will continue to contribute in this sphere with the following activities:

(a) Studies on technology and spectrum utilization for space communications which will be continued in the study period 1990-1994, in the light of technological developments by CCIR study groups 1, 4, 5, 7, 8, 10, 11 and 12;

(b) Supplement No. 1 (Effect of WARC-88 Decision) to the CCIR Handbook on Satellite Communications (Fixed-Satellite Service) is expected to be published by October 1990. Supplement No. 2 (Computer Programmes for Satellite Communications), currently under preparation, will be published in 1991. Supplement No. 3 (Very Small Aperture (VSAT) Systems and Earth Stations) and Supplement No. 4 (Satellite Links in the Integrated Service Digital Network (ISDN)) are in preparation and will be published at a later stage;

(c) The CCIR handbook on satellite-based services of time and frequency dissemination, currently under preparation, is expected to be finished by the end of 1991;

(d) The International Telegraph and Telephone Consultative Committee (CCITT) is actively continuing its work on a study programme concerning space technology (see A/AC.105/389, para. 56 (c));

(e) Organization of biennial seminars on frequency management and the use of the radio frequency spectrum and the geostationary satellite orbit by the International Frequency Registration Board (IFRB), with a view to providing direct technical assistance to the participating countries;

(f) Publication in the ITU Telecommunication Journal of a list of satellites launched, together with their summary descriptions. Recapitulatory tables will also be published annually;

(g) Publication of ITU's Report on Telecommunication and the Peaceful Uses of Outer Space;

(h) TELECOM 91, the sixth in a series of quadrennial World Telecommunication Exhibitions, will take place at Geneva from 8 to 15 October 1991, highlighting the general theme "An interconnected world: improving the quality of life for all". It will inform the 166 member countries on the latest advances in telecommunication techniques for the benefit of the members of the Union, in particular the developing countries. It will display exhibits on uses of telecommunication systems, products and services. The prestigious World Telecommunication Forum will be held, consisting of separate symposia on policy, technical and legal, possibly on two other sectors of finance and economy, a World Book Fair on Telecommunications and Electronics, the Golden Antenna Film Festival and the traditional international context of "Youth in the electronic age".

103. IFRB publishes quarterly an updated list of the orbital positions assigned to space stations on board geostationary satellites, together with frequency bands

used by those stations (as communicated to IFRB in the framework of articles 11 and 13 of the Radio Regulations). Also, IFRB updates and publishes lists (List VIIIA) providing comprehensive information on satellite systems, including particulars on Earth stations, space stations and radio astronomy stations.

104. WHO will continue its efforts to develop and strengthen communications systems in support of primary health care gained by promoting the exchange of information and experiences, by recommending effective communication policies.

105. ECA will continue to provide technical inputs to the publication RASCOM Bulletin, which provides progress reports on the RASCOM feasibility study for the various national co-ordination committees.

106. The United Nations is planning a world-wide telecast in 1992 as part of the International Space Year activities. The telecast would coincide with the United Nations Conference on Environment and Development to be held in Brazil and with the World Space Congress to be held in Washington. The telecast would include a panel discussion by reknowned experts on the subject of "Mission to Planet Earth". The panel members would also address the relevance of the programmes beyond ISY, including the importance of the participation of the developing countries.

107. The United Nations is discussing with the International Telecommunications Satellite Organization (INTELSAT) and with the International Organization of Space Communications (INTERSPUTNIK) the possibility of their providing a free space segment for the above telecast and of requesting their signatories to provide for the necessary ground segments, also free of charge. The United Nations will invite interested bodies of the United Nations system to co-sponsor the telecast and to participate in developing the substance of the programme and in structuring the telecast.

4. Regulation of the use of the geostationary satellite orbit and the radio-frequency spectrum allocated to space communication services

108. The Legal Sub-Committee of the Committee on the Peaceful Uses of Outer Space will continue in 1991, subject to decision by the General Assembly, to consider matters relating to the definition and delimitation of outer space and the character and utilization of the geostationary orbit, including consideration of ways and means to ensure the rational and equitable use of the geostationary orbit without prejudice to the role of ITU.

109. The outcome of the World Administrative Radio Conference on the use of the geostationary orbit (WARC-ORB-88), held at Geneva in 1988, requires additional studies and post-conference activities in several areas that the permanent organs of ITU will carry out in 1991 and subsequent years, leading to WARC-92 (see para. 111 below), related to: (a) technical characteristics of 30/20 GHz band, interference criteria and sharing criteria applicable to the fixed-satellite services; (b) sound broadcasting satellite service in the frequency range 500 MHz-3,000 MHz; (c) appropriate system specifications for the satellite broadcasting of high-definition television (HDTV); and (d) implementation of the

frequency allotment plan included in the Final Acts of WARC-ORB-88 for the fixed-satellite service in the 6/4, 13/10, and 13/11 GHz frequency bands.

110. CCIR Study Group 4 will study further the technical characteristics of the 30/20 6Hz band, inteference criteria and sharing criteria as well as update technical parameters applicable to the fixed-satellite service. CCIR Study Group 11 established an active work programme for the 1990-1994 study period to prepare the technical information (including interference and frequency-sharing criteria) required to identify a suitable world-wide frequency band for HDTV. CCIR Study Groups 10 and 11 have set up a detailed work programme for the 1990-1994 study period to develop appropriate system specifications and to examine interference conditions as well as to establish sharing criteria for a satellite sound broadcasting service in the frequency range 500-3,000 MHz (see para. 141 below).

111. ITU will hold a World Administrative Radio Conference in Spain in 1992 to deal with frequency allocations in certain parts of the spectrum, particularly those involving mobile satellite and broadcasting satellite services and for space research services. The XVIIth Plenary Assembly of CCIR has approved the resolution on the preparation of the technical bases of the Conference.

112. In accordance with the the ICAO Special Committee on Future Air Navigation System (FANS), the ICAO Council agreed that FANS would resolve current shortcomings in safety, improve air traffic control and provide global communications and establish a new Special Committee (FANS II) to establish institutional arrangements for global satellite-based communication navigation and surveillance and air traffic management systems (see A/AC.105/444 and Corr.1, para. 97).

113. WIPO will continue to study various aspects of copyright law that relate to the transmission of programmes by satellite, in particular the preparation of Model Law on Copyright. Furthermore, in the draft programme and budget for the 1990-1991 biennium, it is envisaged that a number of copyright questions relating to, inter alia, satellite transmissions, will be dealt with in the context of a possible protocol to the Berne Convention for the Protection of Literacy and Artistic Works.

C. METEOROLOGY AND HYDROLOGY

1. Education and training programmes

Training courses/workshops/seminars

114. WMO plans to continue collaborating with the United Nations, FAO, ESA and other organizations in the co-sponsorship of training events during 1991, including the following:

(a) Training Seminar on the Use of Environmental Satellite Data in Meteorological Applications;

(b) Training Course on Tropical Meteorology and Tropical Cyclone Forecasting (1992);

(c) Workshop on Extra-tropical and Tropical Limited Area Modelling;

(d) Workshop on Asian/African Monsoons Emphasizing Training Aspects.

115. The WMO proposals for satellite-related events for 1991 include the following:

(a) Training Seminar on the Integrated World Weather Watch (WWW) System Management;

(b) Training Seminar on WWW Data Management and Monitoring Aspects;

(c) Regional Roving Training Seminar on Tropical Cyclone Forecasting (1991);

(d) Regional Workshop on Tropical Cyclone Warnings (1991).

These meetings will be organized in close collaboration with the United Nations and specialized agencies within the United Nations system such as ICAO and FAO, as well as with ESA.

116. ECA, in collaboration with UNEP and WMO and other concerned United Nations agencies, will continue to carry out activities within the framework of the African Centre of Meteorological Applications for Development (ACMAD) which will include training courses/workshops/seminars in the applications of meteorology and agrometeorology and related activities as well as the use of satellite information in weather forecasting, mapping climatic zones and developing guidelines for early warning systems. During the 1991-1992 period and beyond, co-operation between ACMAD and the Centre for Agrometeorology and Operational Hydrology (AGRHYMET) will be strengthened in utilizing the satellite for meteorological data collection (see A/AC.105/444 and Corr.1, para. 101).

Fellowships

117. Through its regular budget or short-term fellowship resources, WMO financially supports the attendance of some participants at the training events which it sponsors, as described in paragraphs 99 and 100 above.

118. Through the United Nations Space Applications Programme, ESA has renewed its offer of a one-year fellowship in the field of satellite meteorology, tenable at the European Space Operations Centre (ESOC), Darmstadt, Germany, in 1991.

119. ECA and WMO received pledges from the Governments of Canada, the United Kingdom of Great Britain and Northern Ireland, France and a number of other bilateral donors towards short-term fellowships for assistance to ACMAD in: (a) training of African scientists and middle-level technicians through workshops, seminars and refresher courses; and (b) subvention of African research fellows and senior scientists as visiting scholars to benefit ACMAD in the implementation of its work programme (see A/AC.105/444 and Corr.1, para. 104).

120. ITU will offer fellowships in 1991 in connection with the design and the operation of meteorological ground stations in co-operation with the Romanian Electronics Research Institute.

2. Expert services and survey missions to identify specific areas of applications relevant to a given country or group of countries and to carry out specific studies on pilot projects

121. Following the recommendations of the United Nations Meeting of Experts on Remote Sensing and Satellite Meteorology Applications to Marine Resources and Coastal Management in the Atlantic Coast of Africa Region, held at Maspalomas, Gran Canaria, Spain, in 1989 (see A/AC.105/436), the United Nations Programme on Space Applications, in consultation with UNDP, the specialized agencies, ESA, and Member States in the Atlantic coast of Africa region, is considering the establishment of a regional programme/project on the use of space technology in various oceanographic/coastal environment fields.

122. In accordance with the recommendations of the United Nations IOMAC meeting held at Karachi, Pakistan, in July 1989, (A/AC.105/439, paras. 12-35), arrangements are being made for a pilot project with the NOAA/National Environmental Satellite Data and Information Service (NESDIS) consisting of two teams of four to five remote sensing scientists from the IOMAC member States to work together for about six months. Consultations are also being made with UNDP to support an IOMAC programme for an integrated marine space applications project and a regional information service. As part of the IOMAC programme, three remote sensing projects will be carried out, in Indonesia, Sri Lanka and Tanzania respectively.

123. The application of satellite technology in meteorology and operational hydrology forms an important element of the technical co-operation activities of WMO. These activities are undertaken generally with assistance from the voluntary co-operation programme of either WMO or UNDP. The following activities are planned for 1991-1992 and future years:

(a) Africa. A number of countries, including Germany, France, the United Kingdom and the United States, are donating data collection platforms (DCPs) for the collection of meteorological data via the geostationary meteorological satellite Meteosat to 15 countries in Africa in order to o upgrade meteorological observations. They are being installed in Ethiopia, Kenya, the Sudan and other countries as part of an operational World Weather Watch System Evaluation for Africa. The project also includes the installation of DCP retransmission stations (DRS) in various national meteorological centres and the meteorological data dissemination function of the Meteosat Operational Programme. A receiving station (NOAA, AVHRR and Meteosat) has been installed at the AGRHYMET Centre, in the Niger, within the framework of the French/United States contribution to the AGRHYMET Programme Phase III (1987-1991) which permits the Centre to receive daily real-time data from NOAA satellites and meteorological information from Meteosat. A pilot project consisting of the installation of DCPs using the Meteosat system is being implemented in Morocco for flood forecasting purposes. A multi-donor project is now under preparation to monitor the weather conditions affecting development, growth and movements of desert locusts in Africa. Under this project 50 automatic

stations will be installed. In the Niger river basin, 64 DCPs using the Argos system will be installed.

(b) Asia. UNDP provided valuable assistance to developing countries in Asia and the South Pacific region through national as well as regional projects. Satellite ground stations were installed in Mongolia, the Democratic People's Republic of Korea and Sri Lanka. Eighteen participants from 13 countries, in addition to participants from the host country, attended a three-week training workshop on satellite meteorology held at Beijing. A UNDP country programme in China is providing a modern satellite data archiving and retrieving system. Some Pacific island countries will be provided with DCPs with UNDP support.

(c) Americas. As part of a project of the Finnish International Development Agency (FINNIDA), satellite communications are planned to be used for the CEMET (Central American meteorological telecommunications network) circuits in Central America. In Colombia, 25 DCPs are being installed in the Magdalena-Canoa basin for hydrological forecasting purposes using NOAA geostationary environmental satellites (GOES).

124. ECA in co-operation with WMO and other United Nations agencies will offer advisory services to Member States in developing institutional capabilities utilizing remote sensing data from meteorological satellites.

3. Dissemination of information on the status of technology

125. The long-term plan of WWW (WMO), which extends to 1997, emphasizes satellite technology for obtaining meteorological data through remote-sensing techniques. Satellite-based data collection and dissemination systems are being increasingly used in WWW's Global Telecommunication System (GTS). The application of satellite technology is particularly important in activities carried out under the Tropical Cyclone Programme (TCP) to mitigate disasters caused by tropical cyclones. TCP aims at improving the capability of national meteorological and hydrological services to provide forecasts and timely warnings of violent winds, torrential rainfall, floods, storm surges and landslides/landslips caused by tropical cyclones. These activities are based on the WWW and operational hydrology programmes of WMO, which take into account the remote sensing and data transmission capabilities of satellites.

126. Considerable efforts continue to be undertaken within WMO to provide information on developments in the International Maritime Satellite Organization (INMARSAT) and to promote its application among WMO members, as well as to assist its members in adapting their marine observations and services systems to meet the new and changing requirements.

127. The use of data collection capabilities on geosynchronous meteorological satellites is growing rapidly. Of particular importance is the use of the International Data Collection System, where the main emphasis is on obtaining data from over ocean areas. Two systems, carried on board a ship and aircraft to collect high-quality aerological data through meteorological satellites, have been developed for use in WWW. Implementation began in 1988 and will continue for

several years. The use of data dissemination capabilities on geosynchronous meteorological satellites is also developing. The Meteorological Data Distribution Service provided via Meteosat was put into operation in January 1990 and will dramatically improve the reception of meteorological information, particularly in Africa. A similar service is being planned on the geostationary meterological satellite operated by Japan.

128. The overall long-term goals of the WMO/ICSU World Climate Research Programme (WCRP) are to determine to what extent climate can be predicted and the extent of man's influence on climate (see A/AC.105/389, para. 84, and A/AC.105/444 and Corr.1, para. 115). These goals are being implemented as follows:

(a) The scientific plan for WCRP gives high priority to understanding the effects of cloudiness on the radiation energy budget (see A/AC.105/373, para. 68, and A/AC.105/444 and Corr.1, para. 115 (a)). The International Satellite Cloud Climatology Project (ISCCP), established in July 1983, had as its aim the establishment of a five-year global radiance and cloud data set based on observations from the international array of geostationary meteorological satellites and operational polar-orbiting satellites. The project has been extended through June 1995;

(b) Two major observational programmes are involved within WCRP: the study of the inter-annual variability of the tropical ocean and the global atmosphere (TOGA), 1985-1995 (see A/AC.105/342, para. 88 (b), and A/AC.105/444 and Corr.1, para. 115 (b)) and the World Ocean Circulation Experiment (WOCE), 1990-1995 (see A/AC.105/309, para. 104, and A/AC.105/444 and Corr.1, para. 115 (b)). The decision of France and the United States to proceed with the implementation of the joint Typhoon Operational Experiment (TOPEX)/POSEIDON altimetric mission in 1991 and the preparation of the European oceanographic satellite mission, ERS-1, in 1990 are of particular importance for the success of WOCE;

(c) In addition to ISCCP, WCRP has initiated projects to produce monthly fields of sea surface temperature and precipitation; these projects require substantial amounts of satellite observations;

(d) Finally, WCRP is preparing a "Global energy and water cycle experiment" (GEWEX), planned for 1995-2000 (based on the multinational Earth Observing System), to obtain information on atmospheric thermodynamics, global water transport and land surface processes not available through the existing operational systems (see A/AC.105/415, para. 110 (d), and A/AC.105/444 and Corr.1, para. 115 (d)).

129. Within its training publications programme, WMO updates publication No. 240, Compendium of Training Facilities for Meteorological and Operational Hydrology, which, inter alia, contains descriptions of training courses offered by a number of countries on the subjects of satellite meteorology and its applications. The publication will be distributed to all WMO member countries.

130. UNEP and WMO continue to co-operate, both through GEMS and within the framework of the World Climate Programme. Climate system monitoring focuses on observation of meteorological data, monitoring of the global climate system and analysis of anomalous weather situations. Some of the data concerned are derived

from satellite sensors. UNEP, UNESCO and the Swiss Federal Institute of Technology continue to co-operate in a World Glacier Inventory. The results will be published in 1991 and 1992. A modern, fully computer-based service that includes satellite observation in remote regions for advanced analysis of glacier and climate data will be developed.

131. UNEP and WMO, as part of their ongoing close co-operation on the issue of climate change, and WMO itself, through its World Climate Programme, continues to monitor stratospheric ozone for use in assessments of ozone layer modifications resulting from changes in abundances of chloro-fluorocarbons (CFCs) and other ozone depleting substances. The information obtained by WMO through satellite monitoring activities contributes significantly to the activities of the assessment panels established by the Ozone Secretariat, which is responsible for implementing the decisions of the Conference Parties to the 1987 Montreal Protocol on Substances that Deplete the Ozone.

132. Climate monitoring activities within the world climate data programme involve satellite data covering sea ice, snow cover, solar radiation, aerosol optical depth, albedo and clouds (see A/AC.105/359, para. 80). The climate data referral system (INFOCLIMA) includes information on some available satellite data sets needed for climate monitoring and research. The world climate applications programme continues to investigate and promote the development of potential uses of satellite data in climate applications. WMO recently established the major climate change detection projects in the framework of which satellite data are intended to be widely used.

133. A new Global Atmosphere Watch (GAW) system has been established to serve as an early warning system to detect changes in the greenhouse gases, including ozone, and pollutants. Ground observations made in the background air pollution monitoring network (BAPMON) will continue to provide information required to verify future satellite-based observations of some atmospheric constituents. The Global Ozone Observing System (GO^3 OS), guided and co-ordinated by WMO, will measure the atmospheric ozone with more than 150 ground-based stations. It has been supplemented in the last decade by a few satellite observing systems.

134. The WMO Commission for Atmospheric Sciences (CAS) continues to rely on the use of satellite data for research, for both climate studies and weather analysis and prediction of all time scales (see A/AC.105/444 and Corr.1, para. 120). The CAS working groups, especially those on climate research and weather prediction research, co-ordinate their activities related to satellite data utilization for research with the Executive Council Panel of Experts on Satellites and other bodies concerned. As an implementation action of the WMO Programme on Short- and Medium-range Weather Prediction Research (see A/AC.105/373, para. 72), the application of high-resolution quantitative satellite data will be studied.

135. Based on the structure of WMO's hydrology and water resources programme, a number of projects relating to hydrological networks and instrumentation, hydrological forecasting methods and systems and the application of remote sensing techniques to operational hydrology are being undertaken. The results of much of this work will be available at the end of 1992. A technical report on the application of remote sensing to hydrology is expected to be published in 1990.

136. The WMO Commission for Marine Meteorology (CMM) and the Joint IOC/WMO Working Committee for IGOSS maintain a close interest in the use of satellites for both ocean measurement and communications. A CMM rapporteur is preparing a technical report on the use of satellite data in the provision of marine meteorological services (see A/AC.105/415, para. 115).

137. ECA will continue to encourage member States to strengthen their national collecting stations through the use of GTS and national telecommunications hubs for timely dissemination of meteorological information and data. National weather bulletins will be given wider circulation to reach relevant departments and the rural population.

138. WMO publications are listed in A/AC.105/444 and Corr.1, paragraph 125.

139. UNESCO will continue to publish, within the framework of the International Hydrological Programme, technical reports on new developments concerning the application of remote sensing of water resources.

140. UNEP, through GEMS, together with the WMO World Climate Programme, COSPAR and the International Association of Meteorology and Atmospheric Physics, will continue to support the International Satellite Land-surface Climatology Project (ISLSCP). ISLSCP has developed and improved algorithms for the evaluation and interpretation of the satellite-borne measurements to obtain climatologically useful information. Following successful experiments in Denmark (Greenland), France, the Niger and the United States, a number of ISLSCP studies are planned in western China, northern Sudan and Botswana to validate satellite data for different environmental situations and to obtain new information about the applications of satellite data for land-surface studies. A hydrological atmospheric pilot experiment study will be carried out in the Niger in the 1990s. Other studies to be undertaken in this time frame include a boreal forest experiment in Canada and another principal experiment in Spain.

141. ITU CCIR Study Group 7 will continue to study questions relating to the meteorological-satellite service and associated technologies through the next study period, 1990-1994, in accordance with the decision of the XVIIth Plenary Assembly of CCIR.

D. BASIC SPACE SCIENCE

142. A United Nations workshop on basic space research is planned to be held in India in co-operation with the Government of India in July 1991, for the benefit of the ESCAP member States.

143. Through the United Nations Programme on Space Applications, the Government of the USSR is offering six nominal fellowships in the following disciplines: S. P. Korolev Fellowship Awards (two) for studies in scientific instrument manufacturing; Ya. B. Zeldovich Fellowship Awards (two) for studies in theoretical and experimental physics; M. V. Keldish Fellowship Award (one) for studies in systems and methods of space information processing; and K. E. Tsiolkovsky Fellowship Award (one) for research in the uses of space technology for the study

of the Earth's rotation and the movement of the lithosphere plates. These fellowships are being offered at the post-graduate level for the benefit of developing countries and will each be of a duration of three years. The starting date for the fellowships is 1 December 1990.

E. LAND, MARITIME AND AERONAUTICAL MOBILE SERVICES

144. Following the 1988 IMO Maritime Safety Conference, the International Convention for the Safety of Life at Sea (SOLAS) amendments should enter into force on 1 February 1992. The Global Maritime Distress and Safety System (GMDSS) will be introduced in stages between 1993 and 1999. Satellite communications form a major part of GMDSS and ships, are being encouraged to fit satellite equipment. The organization is also continuing the preparation of a master plan of shore-based facilities for GMDSS.

145. The further development of GMDSS to provide for its orderly introduction will be continued by IMO in close co-operation with ITU/CCIR, WMO, the International Hydrographic Organization, INMARSAT and the system for search-and-rescue operations (COSPAS-SARSAT) the space system for Search and Rescue System for ships in distress, and Search and Rescue Satellite-aided Tracking space project (USSR).

146. The WHO Regional Office for Europe will continue to test a disaster management work programme. For disaster management, the programme will undertake research and development activities in a few countries to assess the feasibility and efficiency of using the INMARSAT services TT-3020A Standard-C Satellite Transceiver for receiving and communicating information on disasters for prompt and appropriate response. The services were tried out at the time of the earthquake in Armenia on 7 December 1988. As appropriate, the experience is being shared with all other WHO officers.

147. IMO has undertaken studies on a world-wide radio navigation system and adopted a policy for recognition and acceptance of such systems (IMO resolution A.666 (16)). On the basis of that policy, amendments to the 1974 SOLAS Convention will be considered when IMO is satisfied that a suitable radio-navigation system meeting its requirements is operational.

148. IMO, in close co-operation with the International Hydrographic Bureau, is also undertaking a study for a world-wide system of transmission and electronic display of nautical information on board ship, including means of updating the electronic navigation chart, which will be broadcast through the INMARSAT enhanced group and safety net system. Equipment based on a provisional performance standard is being developed and tested.

149. ITU-CCIR Study Group 8 (mobile services), and particularly its interim working party (IWP 8/14), will continue to deal with technical and operating characteristics necessary for compatibility, inter-operability and the required performance levels for systems in the mobile satellite services as well as terrestrial aeronautical public correspondence.

150. Through the ICAO implementation of FANS, two air traffic service providers, the Union of Soviet Socialist Republics and the United States, agreed to implement the Global Orbital Navigation Satellite System (GLONASS) and the Global Positioning System (GPS), GLONASS to become operational not later than 1995 and GPS, in 1992 (see A/AC.105/444 and Corr.1, para. 139).

F. OTHER ACTIVITIES IN THE FIELD OF SPACE SCIENCE AND TECHNOLOGY AND ITS APPLICATIONS

151. The United Nations plans to issue at a future date a United Nations directory on publications and literature with particular emphasis on remote sensing and photogrammetry, in collaboration with the International Society of Photogrammetry and Remote Sensing.

152. Through its Programme on Space Applications, the United Nations will continue to collaborate with COSPAR by providing support that would enable the participation of scientists from developing countries in the 29th plenary meeting of the Committee, to be held in 1991.

153. The Legal Sub-Committee of the Committee on the Peaceful Uses of Outer Space will continue in 1991, subject to the decision of the General Assembly, to elaborate draft principles relevant to the use of nuclear power sources in outer space and to consider the legal aspects related to the application of the principle that the exploration and utilization of outer space should be carried out for the benefit and in the interests of all States, taking into account the needs of developing countries.

G. INTERNATIONAL SPACE YEAR ACTIVITIES

154. The United Nations and its specialized agencies will continue to collaborate on preparations for the International Space Year (ISY) activities (see, e.g., paras. 13 (d), (m), (n), 48, 106 and 107 above). Additional proposals will be reviewed at the 1991 inter-agency meeting. This is in conformity with General Assembly resolution 44/46 of 8 December 1989, by which the Assembly endorsed the initiative of international scientific organizations and bodies to designate 1992 as International Space Year and the recommendations of the Committee on the Peaceful Uses of Outer Space that international co-operation should be promoted through ISY and carried out for the benefit and in the interests of all States, taking into particular account the needs of developing countries, and that the training and educational capabilities of the United Nations Programme on Space Applications should be utilized to bring about a meaningful role for the United Nations, through voluntary contributions by Member States and without any impact on the regular budget of the United Nations or the existing programme of work of the Programme.

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5 October 1990

ORIGINAL: ENGLISH

COMMITTEE ON THE PEACEFUL
USES OF OUTER SPACE

INTERNATIONAL MARITIME SATELLITE ORGANIZATION: ANNUAL REVIEW 1989

Note by the Secretariat

The attached annual review 1/ has been submitted by the International Maritime Satellite Organization (INMARSAT) for the attention of the Committee on the Peaceful Uses of Outer Space. The review has been made available by INMARSAT at this time in English, French, Russian and Spanish.

Notes

1/ In view of the limited number of copies received, the review is distributed to the members of the Committee only.

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ORIGINAL: ENGLISH

COMMITTEE ON THE PEACEFUL
USES OF OUTER SPACE

REPORT OF THE EUROPEAN TELECOMMUNICATIONS SATELLITE ORGANIZATION

Note by the Secretariat

The European Telecommunications Satellite Organization (EUTELSAT) has submitted the attached report 1/ on its activities covering the year 1989 in English and French only.

Notes

1/ In view of the limited number of copies received, the report is distributed to the members of the Committee only.

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